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AMERICAN SOCIETY OF CIVIL ENGINEERS

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VALUATION FOR THE PURPOSE OF RATE-MAKING.

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REPORT OF THE SPECIAL COMMITTEE  
TO FORMULATE PRINCIPLES AND METHODS FOR THE  
VALUATION OF RAILROAD PROPERTY  
AND OTHER PUBLIC UTILITIES.

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DECEMBER 1st, 1913.

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# AMERICAN SOCIETY OF CIVIL ENGINEERS

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### VALUATION FOR THE PURPOSE OF RATE-MAKING.\*

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The Committee appointed by the Board of Direction in September, 1911, to formulate principles and methods for the valuation of railroad property and other public utilities has carefully considered the matters referred to it, and respectfully presents a report covering the subject of Valuation for the Purpose of Rate-Making.

Valuations of the property of public service corporations may be made for a variety of purposes, the most important of which are the furnishing of a basis for the regulation of rates and for taxation, capitalization and purchase.

It is sometimes held that valuations for all of these purposes should give identical results. This view cannot prevail if the laws of the different States and certain decisions of the Courts are complied with. For instance, there are in many States laws indicating how the property of public service corporations shall be valued for taxation and these laws differ radically in their requirements. There are other reasons why the valuation for different purposes should differ, but this feature will not be discussed at present as this report will, as stated, relate to valuation for the purpose of rate-making.

It is, of course, true that the principles and methods of valuation for rate-making are in most respects the same as those involved in the valuation for other purposes.

The valuation of public utilities has attained special importance in recent years and most of the literature relating to this subject has been issued within the last thirteen years. The principles and

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\*The Committee reserves the right to make insertions in its report, such, for instance, as additional examples of overhead charges, depreciation allowances, etc. The report is presented at this time, without awaiting the assembling of this additional material, in order to comply with the Society's rule regarding the presentation of reports sixty days before the Annual Meeting.



methods involved are now being carefully considered by many public service commissions and the Courts, as well as by engineers, lawyers, and committees of various societies having to do with public utilities. The subject is clearly in the developmental stage, and any conclusions reached at the present time must be considered as tentative.

Until recently there were few, if any, engineering or legal works devoted exclusively to the valuation of public service properties, but during the year 1912 and since, several extended and valuable works upon this subject have issued from the press. Especially noteworthy is a comprehensive work of Mr. Robert H. Whitten\*, a book of nearly 800 pages, which contains a well arranged, clear and concise discussion of the various principles involved in the valuation of the property of public service corporations and is replete with extended quotations from the opinions of the Courts. Your Committee has been greatly aided in its work by Mr. Whitten's contribution to the solution of this difficult problem.

It is obvious that a valuation for use before a Court or public service commission must, in order to be sustained, be made in conformity with existing laws and the decisions of the higher Courts. It is recognized, however, that the whole subject is in a developmental stage, and while your Committee has been guided largely by the decisions of the higher Courts and public service commissions, it recommends what seem to be sound views and desirable changes in practice, even though not wholly in accord with such decisions.

#### GENERAL PRINCIPLES INVOLVED IN VALUATION FOR RATE-MAKING.

The primary requirement in the valuation of a public service property is that justice shall be done both to the owner of the property and to the public. The valuation is for the purpose of determining rates which shall be a limitation of charges to those which will give a fair return and no more. In some degree the power assumed by the public to limit rates implies a guaranty, in the case of a properly managed normal property, of such fair return, and an assurance to the public of satisfactory service in consequence of such implied guaranty. The exercise of the power to regulate rates should be based on equity to both parties.

It has been well settled by the highest Courts that the owner of such property is entitled to a fair return upon a fair value of the property utilized in or reasonably necessary to the service.

These general principles do not enlighten one as to how the fair value and fair return are to be determined, but they indicate a purpose, and it is often helpful to test any proposed method of determining value by the application of these principles.

\*"Valuation of Public Service Corporations," by Robert H. Whitten. Ph.D. New York, 1912.

Justice and equity require that in any regulation of rates fixing the amount which may be earned by a public service corporation there shall be taken into consideration two distinct features.

First, the annual return covering interest and profit, to which the corporation is entitled for the use of its capital, having in view the risks incidental to the investment.

Second, an allowance sufficient to provide for the net depreciation in the value of all the items of physical property, whether resulting from decay, wear and tear, or other cause, the amount of such depreciation allowance to be sufficient to amortize all such items of property by the time they cease to have value.

The principles are similar to those involved where one man loans money to another. It is not enough in such a case that the borrower should pay interest on the money loaned, but he must also pay the principal to cancel his indebtedness.

In many instances there has been a failure to recognize this principle in the case of public service properties by reason of the consideration of the property as a whole and not as the sum of its parts, and the situation becomes much clearer when one considers separately each item of property having a limited life. Each such item may be said to have a value when new equal to the capital invested in it, and by the time such item ceases to have value, the corporation is entitled to have received from the public the full amount of its capital; at least this is the general principle involved.

It is obvious that a fair return must include not only the items above mentioned, but must include sums sufficient to cover operating expenses, taxes, and all other current expenses, and such portion of the cost of maintaining the property in good condition and of replacing portions of the property as are not covered under the head of the depreciation allowance. The line of separation between maintenance and replacements, on the one hand, and the depreciation allowance on the other, will be discussed later in one of the sections under the head of Depreciation.

Public policy requires that, in the absence of any plan for public ownership of public service property, the earning capacity of such properties be made sufficiently attractive to induce capital to provide the works needed for the public welfare and convenience, to maintain them in proper condition for providing good service and to extend them reasonably in advance of the needs of the community. The public may be as injuriously affected by too low as by too high rates.

If the public regulation of rates to be charged by public service corporations is to become general, the fairness and uniformity of methods of valuation for rate-making will have an important influence upon the supply of capital for such enterprises, and upon their

maintenance and development so that they will furnish satisfactory service to the public.

#### FAIR VALUE FOR RATE-MAKING.

As already indicated, no complete and definite rules have been laid down for the determination of the fair value of a public service property. The matter is so difficult that Courts and commissions have in the majority of cases stated that they have given weight to valuations determined by several different methods, and that, after due consideration, have reached a certain conclusion which they announce without disclosing definitely the method by which the conclusion has been reached. This appears to have been a wise course to pursue during the developmental stage of this subject, in view of the weight as a precedent given to important Court decisions.

In all private transactions the controlling feature in the valuation of a property which has a capacity for earning is the probable future earning capacity, and this, while considered from many points of view, is determined mainly from the financial history and present physical condition of the plant. The value obtained in this way is substantially what would be the market value of the property were there conditions creating a market, and is the amount which a willing and intelligent buyer desiring such property would give for it to a willing and intelligent seller.

During former periods when rate regulation was rarely enforced, the value of the public service properties was determined in substantially the same way as the value of private property, and at the present time the stocks and bonds of such properties are valued to a large extent on the basis of their earning capacities.

As the future earning capacities of such properties under rate regulation by commissions will to a large extent depend upon rates to be established as a result of valuations of the properties, it is clearly illogical to base the valuations on present or past rates. Such valuation would be reasoning in a circle. The value used for rate-making should be determined in such a way as to lead to equity as between the owner, on the one hand, and the customer or the public on the other.

There are some cases where, on account of high cost of construction and operation, competition, or other reasons, public service properties will not furnish an adequate return on the investment whatever rates may be fixed. In such abnormal cases there can not be what is usually regarded as a fair return upon what would under ordinary conditions be considered the fair value of the property. Such a property may be classed as a losing venture, to which many of the principles and methods applicable to normal properties will not apply.



## METHODS OF DETERMINING PHYSICAL VALUE.

Two methods are in use and have the qualified approval of the Courts; the first of these is based on the actual cost of the work, with suitable provisions for the cost of developing the business in the earlier and unprofitable years of its life, and with deductions for depreciation, etc.; the second method consists of an estimate of the cost of reproducing the property with similar adjustments.

In the case of a property recently created, with accounts kept properly, the best basis for a valuation is the actual reasonable cost as shown by the accounts; in such case the difference between the two methods is nominal, because the best data for an estimate of cost of reproduction will be furnished by the accounts; but it will be necessary to scrutinize the accounts and to examine the property to ascertain whether the construction was carried out in a judicious manner. The criterion should be whether the cost was reasonable. The public should not be required to pay a return upon extravagant or injudicious expenditures; on the other hand, the rates should secure to the owner a fair return on his reasonable outlay.

In the case of an old property, it is generally impracticable to ascertain what the reasonable cost was. If the accounts can be found at all they are likely not to represent fully the cost of the property, owing to the failure of such accounts to properly separate charges for the construction of new work from those for operation and maintenance. Moreover, if the books include only cash payments, they may exclude the value of interest on capital and the value of important services where such services were not paid for in cash.

The difficulty of determining the value of an old property from the accounts is greatly augmented by the fact that the cost has been continuous from the first construction to the present time, and that portions of the cost are being extinguished each year by earnings offsetting the depreciation of the perishable property. The cost at the time the work was first put in service may have little relation to present value or to the present investment. This can best be shown by an illustration:

Take the case of a railroad fifty years old, built at first as a cheaply constructed single-track line, including as a part of the original property cheap land, light iron rails, wooden bridges, wooden trestles over low ground, small stations of wood, and light-weight locomotives. In the course of fifty years some of the land has increased greatly in value, other parts have been abandoned for railroad purposes owing to the relocation of the railroad with easier curves; the iron rails have been replaced from time to time with heavier iron rails, and subsequently with still heavier steel rails; the wooden bridges have been replaced with iron and steel bridges; the trestles have been replaced by solid embankments; the roadbed has been widened from time to time, first in

places for the building of turn-outs or side-tracks, and later continuously for the laying of one or more additional main tracks; the station buildings have been enlarged and subsequently replaced with modern structures of stone or brick, and the locomotives have been replaced from time to time by heavier and more powerful machines.

It is easy to see that under such circumstances the actual cost of the original railroad has very little relation to the value of the corresponding part of the present railroad. The present value on the basis of actual cost should, of course, include all additions, but when one considers the manner in which such additions are made it will be seen that wonderfully good book-keeping would be required to supply intelligible and reliable data for a complete ascertainment of cost. For instance, rails of greater weight have been put into use as they were replaced from time to time, those now in the track weighing about twice as much as the original rails. What railroad manager or accountant could have been expected in past years to discriminate between replacements and betterments so closely as to make the accounts represent the added value of the property due to such changes with a reasonable degree of accuracy? In addition to these difficulties, there is the further one of writing off correctly the value of those items of property which, instead of being replaced, have become obsolescent.

The result obtained after making deductions for obsolescence would be the value of the existing items of property new, which should be further diminished by the net amount of the depreciation of the existing property.

The total amount which would have to be deducted for obsolescence and depreciation would be better appreciated if one, instead of dealing with the method of accounting above indicated, in which the depreciation of property is partly offset by charging replacements to operation, had a set of books showing the cost of construction and equipment, including every item of property built or purchased, whether the original item or a replacement.

If the property under consideration were a railroad fifty years old, there would be very few items of the original plant that would not have gone out of use, so that if the cost of all obsolete items were written off, including all overhead charges appertaining directly thereto, there would remain only the cost of a few long-lived items and the other existing items of property to be considered.

Attention is called to this phase of the question because, if the assumption is correct that the total cost of all obsolete items should be deducted, there remains to be considered only the actual cost of the existing items of property. This method, too, would eliminate the uncertainties inherent in accounts which attempt to charge replacements to operating expenses and maintain the cost of the original items of property on the books as charges against capital.

If the value of a very old property, made up of long-lived items, were ascertained from the accounts, it would contain the feature that similar parts of the property would be valued at widely different rates in accordance with prices at the times when furnished. For instance, in an existing water-works property the pipes laid 45 years ago cost \$65 a ton, those laid 15 years ago, \$18 a ton, and those laid during the past year, \$24 a ton. Such a divergence in the estimated value of essentially identical items of property, although apparently anomalous, is not necessarily inequitable in a valuation for rate-making purposes.

For reasons given, the Committee believes a valuation of an old property based on its actual cost to be generally impracticable, making it necessary to adopt the cost-of-reproduction method. Many questions remain to be settled in the application of this method which cannot be treated in a general statement and will be discussed at length in subsequent portions of the report under the heads of Identical *Versus* Substitute Plant, Unused Property, Present or Original Conditions, Unit Prices, Overhead Charges, Development Expenses, Depreciation and Appreciation.

#### ACTUAL COST METHOD OF VALUATION FOR FUTURE PUBLIC SERVICE PROPERTIES.

In the opinion of the Committee it would be entirely just and equitable, and it is highly desirable to provide by law that future public service properties should be valued on the basis of their actual reasonable existing investment, and to determine or limit rates upon such a valuation if the service rendered permits.

In this case the corporation would and should be relieved from the risk of gain or loss due to the rise or fall of prices of labor and materials, which is sound public policy, since to reduce the risk of investment is to lower the rate at which money can be obtained. A valuation based upon book accounts can be kept up to date by adding to the original valuation the cost of additions and replacements made from time to time to the property, and by deducting the amounts which the corporation is permitted to earn annually to offset the net depreciation of the property.

By this method the considerable expense involved in the revaluation of the property from time to time by the reproduction method would be avoided, and the value obtained would not fluctuate with the variation in the prices of labor and materials. It would also be feasible through changes in the depreciation allowance to amortize abnormal but legitimate costs and to keep the book value of the property reasonably commensurate with its cost of reproduction value, even in the face of rising or falling prices or permanent change in conditions.



IDENTICAL *Versus* SUBSTITUTE PLANT.

In applying the cost-of-reproduction-less-depreciation method, the question has sometimes been raised as to whether the property to be reproduced is substantially the identical existing property or a substitute hypothetical property of modern design, capable of producing the same results as the plant to be valued.

In considering this question from the standpoint of equity to both the corporation and the rate-payer, it is necessary to take into account the amount which the corporation should be permitted to earn annually for depreciation.

If, in computing the annual allowance for depreciation, account is taken only of the lessening of worth of the various items of property due to physical decay approaching inadequacy or obsolescence, it would not be fair to the corporation to further depreciate the value of its property because some new design of works would produce the results obtained by the old plant at a smaller cost.

To illustrate, a water company may have laid main pipes from time to time from its sources of supply to a city, until it has three. In such a case one or two pipes having the same aggregate capacity as the three might be laid at a considerably smaller cost, but it would be unfair to the corporation to diminish the value of its pipes for this reason, unless it had been permitted in previous years to earn an annual sum for depreciation sufficient to cover the lessening of worth due to improvement in design in addition to the sum required to cover physical decay, inadequacy and obsolescence. (See Depreciation.)

Practically it is not good policy to provide this further depreciation allowance or to adopt this theory of value. It is desirable to adopt a uniform method, and there are many reasons why the method of valuing the substantially identical property is preferred.

First, the weight of Court decisions favor this method, although no decision has been given by the United States Supreme Court.

Second, it is much less difficult to determine the reproduction cost of an identical plant than of a substitute plant which will produce equal results. Different engineers would undoubtedly differ greatly in their views as to the location, design and cost of a substitute plant, so that the results might be regarded as speculative and the cost of making the valuation would be largely increased.

Third, allowances for depreciation in the past have generally been too small to make it just to apply the substitutional method to existing properties.

Fourth, the adoption of this theory would substantially increase the depreciation requirements and the charges to be met in the early stages of plant development.



## UNUSED PROPERTY.

It is frequently the case, especially in connection with water-works properties, that land is acquired with reference to its future use, as for instance for storage or distributing reservoirs, or that water rights are bought to meet future needs; and in nearly all old plants there is property which has either been wholly discarded or is maintained for use in cases of emergency. The Courts have generally in theory, and sometimes in practice, excluded property which is unused, and in some cases parts of that used on the ground of unnecessary size or capacity.

The following language has been used in the decisions of the United States Supreme Court referring to the property to be valued:

"Value of property used \* \* \* for the convenience of the public."

"Value of the property actually used for the purpose of supplying water."

"The fair value of its property devoted to the public use."

United States District Judge Farrington, in a San Francisco water rate case, in 1911, ruled that:

"Only that property is to be considered which was then used and useful in supplying \* \* \* water."

In view of these decisions, an engineer in ascertaining a value for rate-making must take into account whether or not the property, although owned by the corporation, is in use. He should also consider whether portions of the plant are unnecessarily large, as a New Jersey Chancery Court in 1905 deducted nearly \$130 000 from a total cost of \$1 400 000, in view of the fact that certain portions of the plant were larger and more expensive than was reasonably required. A part of the deduction was made because a 36-in. main was used where a 30-in. main would have been sufficient, and because a dam was made of excessive width for present purposes in order that it might be subsequently raised.

Judge Savage of the Maine Supreme Court used this illustration\*:

"Suppose that a five-hundred horse-power engine was used for pumping when a one-hundred horse-power engine would do as well. As property to be fairly valued, the larger engine might be more valuable than the smaller one, yet it could not be said that it would be reasonable to compel the public to pay rates based upon the value of the unnecessarily expensive engine."

It seems rather unfair and against good policy that a corporation wisely purchasing, for example, land which has special fitness for its purposes while it is available at a price far below its probably future value, should be required to hold such property without any return on

\* Brunswick and Topsham Water District v. Maine Water Co., 99 Maine, 371, Dec. 14th, 1904.

the investment, and to make such returns would be entirely reasonable and fair to both parties, provided the net income of such land, including its appreciation in value, were credited to the public. On the other hand, it is obvious that a ruling of the Court which permitted the corporation a return on all land purchased might lead to abuses, as the corporation might purchase land for speculative purposes and subsequently dispose of it, so that the community, although paying a return upon its value for a time, might receive no benefit from such land.

While the rulings of the Court in regard to such unused property are not unjust, because the corporation may defer its purchase unless it is willing to take the risk that the advance in value will furnish sufficient compensation for holding the property, it is very desirable, in some cases, in the interests of economy, that the corporation should anticipate future needs. For instance, by purchasing a site on the top of a hill, where a distributing reservoir may be placed, before such a hill property is subdivided into streets and house lots, and by acquiring water rights when they can be obtained at small cost, lest it may later have to pay substantially monopoly prices. This last instance is particularly applicable to the semi-arid and arid regions in the western and southwestern United States.

It is clear that if a corporation does purchase land and water rights before they are required for use, and they are excluded from valuation as a basis for rate determination, later, when they do come into use, their cost should not be the criterion of value but the then value of the property.

While a community should not be required to pay rates upon the full valuation of a plant, which through negligence or very bad judgment has been built of an unreasonably large size, care should be taken in the application of this rule not to omit any portion of the plant on account of large size, if ordinary and reasonable judgment has been used in the designing of the works. Ultimate economy and the convenience of the public require, for instance, that the main water pipes in the streets be made adequate for a considerable period in the future. On the same grounds, a pumping station may wisely be made large enough for the additional pumping engine which will be required in the future, or the lower part of a dam may properly be built with reference to a subsequent increase in height of the dam.

The public service corporation should not be subjected to the hazard of having a part of the value of its plant omitted on account of large size, unless it has been clearly negligent; and the opinion of intelligent engineers as to the provision which should be made for the future differs materially, therefore deductions for the reasons stated should be made only in extreme cases, if at all.

The opinions of the Courts contain discussions upon the exclusion of unused property, or that in excess of present needs, which restrict

the amount of such property to be valued to a greater extent than seems to the Committee to be desirable.

#### PRESENT OR ORIGINAL CONDITIONS.

In the application of the cost-of-reproduction-less-depreciation method a very important question arises as to whether the reproduction cost should be based on the present conditions or on those existing at the time the works were built. A very similar question arises with regard to the valuation of land, whether present or original conditions should be used.

The Committee believes it to be a general basic principle that where money has been expended with due discretion for a public service property, the company is, in the case of a newly created normal property, entitled to a fair return upon a value which, subject to modifications, equals the amount of money invested.

As the same property becomes older some portions depreciate in value as the result of decay and wear and tear, and others appreciate; there may also be a further depreciation or appreciation due to the fall or rise in the prices of labor and materials, and some parts of the property may cease to exist.

Except for these changes, which are often of great importance, and similar changes, all of which result from age, there is little if any difference between the physical valuation of an old and a new property, and the reasonable investment in one should be protected as well as in the other.

In view of these and other considerations, the Committee is of the opinion that valuations should be based upon the physical conditions existing at the time the various portions of the property were built, but at the prices prevailing at or near the time of the valuation. The discussion of the subject may best be approached by taking specific cases.

Take first the Wachusett Reservoir, constructed to supply water to the Metropolitan District of Massachusetts. In constructing this reservoir it was necessary to acquire land upon which were many buildings and mills with their water power. Included in the reservoir site, also, were many highways and two railroads. As a substitute for the highways obliterated, others had to be built around the margins of the reservoir, and some were raised above the water level.

One of the railroads was relocated for many miles at one side of the reservoir and another was raised. To make the reservoir a better receptacle for water, the surface soil was stripped from its whole area. One main dam and two subsidiary dams were necessary for holding the water. Incidentally, under special laws, damages had to be paid for real estate which was not acquired but which was said to be indirectly damaged by the construction of the reservoir.

How should such a reservoir be valued on the basis of the cost of reproduction?

As a newly created reservoir, there seems to be no question but that its value should be substantially its reasonable cost, including engineering, legal expenses, interest during the construction period, and all other overhead charges and incidental expenses. An estimated cost of reproduction should produce the same result except as the value would be modified by changes in prices and by the effects of age.

At present there are in the reservoir no buildings, mills, water powers, highways or railroads except the highways and railroads which were raised.

The title to the highways and the new railroad outside the reservoir vests in the adjacent municipalities and in the railroad company, so that they would not appear in a schedule of reservoir property.

The only way to do justice in such a case is apparently to estimate the cost of reproducing the reservoir on the basis of the original physical conditions, that is, with a knowledge of the buildings, mills, and water powers destroyed and the new roads and railroads necessarily built to take the place of those obliterated.

In other words, due allowance should be made in estimating the cost of reproducing such a reservoir for every reasonable expenditure required by the conditions under which the work was done.

For other examples, consider the great terminal works recently built in New York for the New York Central and Pennsylvania Railroads.

The New York Central terminal has been constructed in a piecemeal manner so as not to interfere with the operation of the trains, and consequently has cost much more than it otherwise would.

The Pennsylvania terminal has been constructed without much interference with the work.

It would obviously be necessary to take into account the different conditions under which the work was done in these two cases in order that the respective roads might have a fair return on money reasonably expended.

In some cases it may be difficult, if not impossible, to ascertain the original physical conditions, although such information should be available except in the case of very old properties. Where such conditions are not clearly known, the person making the valuation should, on the basis of such information as is available, determine as well as he can the probable conditions. For instance, it would be inequitable to assume that a large reservoir site in a settled district had no highways passing through it which required relocation and no buildings upon these highways, or to assume that the land taken for a terminal in a large city did not have buildings upon it.



Equity requires that no real element of value shall be omitted because it is not capable of precise determination.

If the Committee's view that the estimated cost of reproducing a property should be based upon the original physical conditions is correct, many controverted features of the cost-of-reproduction method will be settled and other features will be established.

For instance, the cost of laying a water pipe in a street with an asphalt pavement is much greater than in an unpaved street, and there has been much discussion as to whether, in a case where the pipe was laid before the pavement, the reproduction cost should include the cost of taking up and replacing the pavement. The adoption of the view that original physical conditions govern, necessarily excludes the cost of the pavement.

If after a pipe has been laid in a street new grades were adopted, the reproduction cost of the pipe should be estimated on the basis of the original grades, and if the regrading required a raising or lowering of the pipe already laid, the cost of such work, if not charged against the rate-payers as a part of the current expenses, should be included in the reproduction cost.

It is frequently the case that the greater part of a water-works pipe system is laid from year to year as the population increases and the streets are extended. Where this has been the case, the greater cost of piecemeal construction should be included in the valuation to the extent that that method has been used.

It will also be seen from what has been stated that, if the original conditions govern, it is necessary in valuing a property to consider the required expenditures irrespective of the title to the property. One example is that already given where the Committee has held that the cost of relocating highways and railroads, necessitated by the construction of a reservoir, should be included in the valuation of the reservoir even though the title to these properties does not vest in the owner of the reservoir. Another example is furnished in the case of gas- or water-works systems where the consumers are required to pay the cost of the service pipes leading from the mains to their property. These service pipes are owned by the company, but it would be unfair to include them in the valuation and require the rate-payers to pay rates on property for which they had furnished the capital.

On the same grounds, a street railway company which has been required to lay pavements in connection with its track-laying in the streets should have such pavement included in the inventory when a valuation is made.

In the construction of works required for the separation of highway and railroad grades, the cost is sometimes paid by the railroad and in other cases it is divided between the railroad and the municipality and State. In all such cases the original conditions under

which the separation of grades was accomplished should be considered and the valuation based upon the property created at the expense of the corporation and not upon the present ownership of the property.

In determining what are often called the overhead charges, including preliminary expenses, incidental expenses during construction, and development expenses, the Committee believes that the original conditions should control, as in the case of other items. The adoption of the view that original rather than present conditions should control in determining these charges will have an important bearing upon their amount, because the expense of promoting and developing the original plant is generally a much larger percentage of the total cost than of promoting and developing the additions and extensions made from time to time. The cost of engineering and administration for additions may be as large as for the original plant.

Although the Committee believes that in such cases as those cited the property to be valued is that which the corporation has paid for rather than that to which it holds the title, there are obviously many cases in which property donated to the corporation should be included in the valuation. As an instance of this kind, land and money may have been donated for the construction of a railway in a location where otherwise it could not have been constructed or would have resulted for a long period in a losing venture.

#### APPLICATION OF REPRODUCTION METHOD OF VALUATION.

For making a valuation by the cost-of-reproduction-less-depreciation method, the engineer first obtains or prepares an inventory (see Inventory) of the several items making up the physical property devoted to the public use (see Unused Property). To each of these he affixes a price or estimated cost based upon prices prevailing at or near the time of valuation (see Unit Prices). These prices, whether based upon the experience of the engineer or upon prices furnished by manufacturers or contractors, do not cover the cost of promoting, organizing and financing a public service property (see Preliminary Expenses), nor the cost of engineering, administration, contingencies, and interest during construction (see Incidental Expenses During Construction), and it is therefore necessary to add sums or percentages to cover these items.

During the early years of the operation of most public service properties a deficiency of income accumulates, which should be included in the valuation (see Development Expenses), and working capital is at all times needed for the operation of the property, which should also be so included (see Working Capital).

While many of these costs are sometimes classed, erroneously, as intangible, they are in fact actual and necessary expenditures for the

creation of the physical property, and should therefore be included the same as other necessary and proper expenses.

In order to complete the valuation by this method, it is necessary to make a deduction from the values obtained, as above stated, for the net accrued depreciation of the physical property due to age and other causes (see Depreciation).

After such deduction has been made, the result is the value of the physical property by the cost-of-reproduction-less-depreciation method. Whether and how far it is or is not a reasonable measure of the fair value of the property upon which a fair return should be made will be considered later (see Should Rates be Based on Physical Value Only?).

#### INVENTORY.

The inventory should be made in much detail and with much care in order to obtain the best results. Even under such circumstances the quantities of material will generally be too small unless those making the inventory recognize that, in practice, the actual quantities nearly always over-run the theoretical or geometrical quantities. Take, for an extreme instance, the dredged channel of the Panama Canal leading from the deep water on the Atlantic side to a short distance beyond the shore line. The Annual Report of the Isthmian Canal Commission to June 30th, 1912, states that the geometrical quantity represented by the excavation of this channel to that date was 10 169 000 cu. yd., while the actual quantity taken out of the channel amounted to 22 886 000 cu. yd., an excess of 125 per cent. The excess in this case was due to the quantity of material washed into the channel by waves and currents.

In the building of an earthen dam across a river of considerable size, it is the rule, rather than the exception, that floods occur which damage coffer-dams and wash away considerable material. If the prices are predicated upon the quantity of earth excavated to make the dam, due allowance should be made for the material washed away or otherwise unavoidably wasted.

Under the specifications usually adopted, the actual weight of cast-iron water pipes and much other metal work is in excess of the geometrical quantity, and due allowance should be made for such overweight.

Where contracts are made at a given price per cubic yard, it is frequently necessary during the progress of the work to make changes which require the taking down and rebuilding of certain parts of the work, and this increases the quantity of work for which the contractor is paid beyond the quantity actually in the final structure.

It is also the case that in the valuation of many public service properties it is practically impossible, within the limits of reasonable



cost of valuation, to make the inventory complete. Under such circumstances it has been customary and is proper to allow a small percentage, varying inversely with the completeness of the inventory, for omissions.

#### UNIT PRICES.

The rulings of the highest Courts indicate quite clearly that it is the present rather than the original prices that are to be used in determining the cost of reproduction; for instance, in the Consolidated Gas Company case,\* decided in 1909, it is stated:

"that the value of the property is to be determined as of the time when the inquiry is made regarding the rates. If the property which legally enters into the consideration of the question of rates has increased in value since it was acquired, the company is entitled to the benefit of such increase. This is at any rate the general rule."

Different views have been held as to whether the prices used should be the current prices at the exact date of the valuation, the prices current prior to the date of valuation for the time necessary for the construction of such works, or the average or "normal" prices for a term of years before the valuation, the last method tending to equalize the fluctuations in prices and thereby produce a more stable valuation.

Valuation for rate purposes is generally made to serve for a term of years, and it seems clear that the prices should not be fixed with reference to occasional fluctuations in the prices of labor and materials but rather at the general or prevailing price for labor and materials, which, as a rule, can be deduced by taking the average or prevailing price for a term of years preceding the date of the valuation. From five to ten years has been adopted as a satisfactory period in many cases, but, where charts are available showing the fluctuations of prices of labor and the principal materials entering into a plant, it is well to select the length of the period with a view to obtaining a fair prevailing price.

In some cases, where there is an evident trend toward higher or lower prices, as for instance, the tendency of lumber to increase in price by reason of the diminished supply, and the tendency in the past for cement and aluminum to decrease in price, because of improvements in the methods of and facilities for manufacturing, the prices adopted should be more nearly the price at the time of the inquiry rather than an average of the prices for a period of years.

#### OVERHEAD CHARGES.

When the items contained in the inventory are multiplied by the corresponding unit prices and the products are added, the result is

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\* *Wilcox v. Consolidated Gas Co.*, 212 U. S., 19, January 4, 1909.



only a part of the cost of creating the physical property, for the reason that the unit prices used are generally based upon the direct cost of similar works, and do not include the indirect or incidental expenses. For instance, in fixing a price for a building, the unit price under most circumstances would be the amount for which a contractor would undertake to build and complete the building, or it might be the estimated cost of supplying the labor and materials for the building, with a due allowance for the profit and expenses of the contractor and sub-contractors. In order to obtain the full cost of a building, it would be necessary to include the fees of architects, the amount paid inspectors, the cost of grading the grounds, the amounts expended for interest, taxes, insurance, and legal expenses, and a fair sum for the value of the time devoted by the owner to the planning and construction of the building.

If the person making the valuation had information as to the cost of a similar building which included all these items there would be little, if anything, to be added to obtain the reproduction cost of the building, but if, as is usually the case, the unit cost does not include such items, material additions must be made in order to determine the true reproduction cost.

The amount of the overhead charges applicable to any property should be determined on the basis of the prices prevailing at or near the time of the valuation, but under the conditions existing when the plant was created. The accurate determination of the amount of the overhead charges presents such difficulty that reasonable actual costs should be used as a basis in the case of fairly new properties where such costs can be determined.

The allowance for overhead charges has generally been substantially under-estimated by commissions and the Courts, as well as by engineers of limited practical experience in construction work. The latter are prone to assume that unit prices bid by contractors or determined during the progress of the work by the inspector are fair measures of its final cost to the owner, but such is rarely the case.

The character and amount of overhead charges are discussed in the following sections.

### Preliminary Expenses.

Before a public service property can be brought into existence or even its construction begun, a considerable amount of money is necessarily expended for promoting, investigating, organizing and financing, and this expense, together with the value of the services of those promoting and organizing the work, should be included in the valuation. The promotion of projects, public and private, has

so often been accomplished by improper or fraudulent methods that the word "promoter" carries with it unpleasant suggestions. It must be recognized, however, that without some man or body of men to promote public service projects they would not exist except under public ownership, and that the services of the promoter are therefore valuable.

The preliminary stage of important developments is often long continued and expensive. For instance, in the case of a large hydro-electric development it is necessary, first, that someone should discover a situation favorable for the development of power and near enough to a market to warrant the consideration of the project. With such a project several steps are usually taken.

First, there is the preliminary study, which must be carried to the extent necessary to warrant expenditures for a further investigation and for obtaining a charter or franchise. Next there is usually a further investigation, with engineering and legal assistance, options are obtained upon the land required for reservoirs and other purposes, reports are prepared, and in general the project is put in shape for presentation to those who may be willing to finance such an undertaking.

At this stage of the proceedings experts are frequently employed to make investigations of the various features of the project, and if their reports are sufficiently favorable, the organization of the corporation is perfected, the bonds are offered for sale, all necessary permits from public authorities are obtained, the acquisition of land and rights is begun, the final surveys and investigations are made, and the preparation of plans and specifications for the construction of the work is carried forward.

If the reports of the experts are unfavorable, the project is usually abandoned, with a considerable loss to those promoting the project. Promotion is a hazardous undertaking, and this feature should be considered in determining the value of the services of the promoter.

The issuing and marketing of bonds involves the payment of a commission to brokers as well as various other expenses, all of which should be included in the valuation, but the discount on bonds due to fixing the interest rate so low that the bonds will not sell at par, should not be so included.

The amount of the preliminary expenses for different projects varies both with the character of the works to be built and the degree of care and skill used in the preparatory work.

The preliminary expenses in connection with ordinary additions and extensions are generally much less than those incurred in connection with the original plant, but they still exist, as for instance, for investigations and designs, for issuing and marketing bonds, and for many other things.

### Incidental Expenses During Construction.

The principal incidental expenses during construction may be classified under the heads Engineering, General Expenses, Contingencies, and Interest and Taxes.

*Engineering.*—Under the head Engineering is usually included not only strictly engineering expenses, but those of other technical employes and of inspectors. It is difficult to draw the line between the preliminary engineering and that during construction, and it is probably best in most cases to include the part of the preliminary engineering expenses connected with the preparation of the final design of the works with those incurred during their construction.

The percentage of the cost of the work represented by engineering differs with the character of the works and with the amount of care and skill exercised in their design and construction. On railroads it is commonly estimated that the engineering cost will amount to 5% of the physical valuation of the property, exclusive of overhead charges. Statistics of the cost of engineering are available in connection with several municipal and other works, as follows:

Metropolitan Water-Works, Massachusetts. This property, costing to the end of 1912, \$42 036 000, is to the extent of \$15 300 000 made up of old works purchased from the City of Boston and others, on which the engineering charge is not known, leaving \$26 736 000, of which the engineering charge was \$2 077 000, equal to 7.77 per cent. Based on the total cost, exclusive of engineering, the percentage is 8.42. These amounts include both the preliminary engineering and that during construction.

New York Water-Works, now in process of construction. The disbursements upon this work to the end of September, 1913, amounted to \$103 178 000. The engineering expense directly attributable to the work under construction amounted to \$10 050 000, equal to 9.78% of the total disbursements for this work. In addition, there were engineering expenses relating to investigations of other drainage areas, which are only indirectly attributable to the work under construction, amounting to \$394 000 or 0.38% of the total disbursements, making the total for engineering 10.16 per cent. It is to be noted, however, that there is included in this case under the head "engineering" the cost of unusually extensive borings and investigations which were not included as an engineering charge upon the Metropolitan Water-Works. There is not included, however, the cost of expensive investigations by sinking shafts at the Hudson River, which, although originally charged to the engineering account, has been deducted because the shafts afterward became a part of the final construction.

Boston Subways. The following table has been compiled from official reports:

BOSTON TRANSIT COMMISSION.  
(1895-1912)

	Total cost.	Percentage of total cost.	Percent- age of con- struction cost.
Subway :			
Engineering .....	\$407 475.48	9.88	11.34
Gen. Expense (inc. Commission).....	131 681.87	3.19	3.68
Construction .....	3 586 002.33	86.93	100.00
Total .....	\$4 125 159.68	100.00	
East Boston Tunnel:			
Engineering .....	\$191 466.57	5.90	6.62
Gen. Expense.....	161 134.78	4.96	5.57
Construction .....	2 894 595.01	89.14	100.00
Total .....	\$3 247 196.36	100.00	
Boston Tunnel and Subway:			
Engineering .....	\$417 866.25	5.05	5.48
Gen. Expense.....	226 441.57	2.73	3.58
Construction .....	7 623 206.56	92.22	100.00
Total .....	\$8 267 514.38	100.00	
Cambridge Connection:			
Engineering .....	\$96 575.46	7.10	8.05
Gen. Expense.....	62 355.20	4.59	5.20
Construction .....	1 199 904.39	88.31	100.00
Total .....	\$1 358 835.05	100.00	

CHARLES RIVER BASIN COMMISSION, BOSTON.

Dam, Lock, Embankments, Marginal Conduits, Etc., Completed 1909.

	Total cost.	Percentage of total cost.	Percent- age of con- struction cost.
Administration .....	\$94 011.97	2.6	3.2
Engineering .....	446 096.03	12.4	15.5
Construction:			
Preliminary ..	\$10 783.86	0.3	
Contracts .....	2 629 671.95	73.1	
Additional ....	237 433.22	6.6	
	2 877 889.03	80.0	100.0
Real Estate.....	179 730.77	5.0	6.2
	\$3 597 727.80	100.0	



*Pennsylvania Railroad Tunnels.*—The cost of engineering for the East River Division of the Pennsylvania Railroad tunnels, amounted to 5.8% of the total cost of the work, including excavation, retaining walls around the station area in New York, the tunnels eastward under the streets and East River to the surface in Long Island, terminal yard in Long Island, and engineering. This is equivalent to 6.1% of the cost, exclusive of engineering.

#### KENNEBEC WATER DISTRICT, MAINE.

New Gravity Water Supply, with Auxiliary Steam Pumping Plant, 1906.

	Total cost.	Percentage of total cost.	Percentage of construction cost.
Administration .....	\$6 161.20	2.30	2.53
Engineering .....	17 872.35	6.69	7.35
Construction:			
Rights of Way .....	962.97	0.36	100.00
Pumping Station .....	20 833.39	7.80	
Steam Plant .....	6 275.59	2.34	
China Lake Pipe Line .....	215 302.93	80.51	
Total .....	\$267 408.43	100.00	

#### LOUISVILLE, KY., SEWERAGE WORKS, 1906 TO 1912.

This Work Consisted of Intercepting Sewers, Trunk Sewers, and a Small Proportion of Lateral Sewers.

	Total cost.	Percentage of total expenditures.	Percentage of payments to contractors.
Administration .....	\$78 025.03	2.09	2.37
Engineering .....	336 544.87	9.00	10.23
Rights of Way .....	12 319.36	0.33	0.37
Castings and Other Metal Work .....	15 461.29	0.41	0.47
Damage Suits (excl. of Rights of Way) ..	8 307.52	0.22	0.25
Amounts of Payments to Contractors .....	3 289 330.89	87.95	100.00
	\$3 739 988.96	100.00	

The above total is exclusive of the cost of preliminary engineering, which involved an expense of approximately \$57 000, equivalent to 1.7% of the construction cost (\$3 289 330.89) shown above.

*Watertown.*—Mechanical filters built in 1903; cost, \$97 065; engineering cost, 5.9 per cent.

*Ogdensburg.*—Sand filters built in 1910; cost of work, \$167 694; engineering charges, 7%, excluding cost of preliminary report, which amounted to \$500.

*Hudson River State Hospital.*—Sand filter plant built in 1904; cost, \$36 000; total cost of engineering, 10½ per cent.

*Peekskill.*—Sand filters built in 1908; total cost, \$63 304; cost of engineering, 7.1 per cent.

*Yonkers.*—Open sand filters, built 1903; total cost, \$50 165; total cost of engineering, 7.3 per cent.

*Yonkers.*—Covered sand filters, built in 1907; total cost, \$106 708; cost of engineering, 8.7 per cent.

*Ithaca, N. Y.*—Filters built in 1903 on a percentage basis under rush conditions; cost, \$192 114; engineering cost, 7 per cent.

*Springfield, Mass.*—Water-works built in 1910; construction of additional supply from Little River, including diversion works, reservoir, filters, and pipe lines; cost, \$1 465 393; cost of engineering, 10 per cent. The basis of computation does not include the sum of \$268 000 paid for land, legal, and other expenses.

*Springfield, Mass.*—Ludlow filters; built in 1906 at a cost of \$43 306, to meet an emergency, and requiring very rigid inspection to secure proper grade of sand and proper sanitary conditions during construction; cost of engineering, including board, livery, cots, bedding, and provisions for inspectors on work, 17 per cent.

It is obvious that the cost of engineering varies with the character of the work. For instance, the construction of an important dam or aqueduct, built in place and requiring skill in designing, and a careful inspection of every part of the work as it is built, requires a larger expenditure for engineering than a large cast-iron pipe line where the cost of laying the pipes in a trench is but a small percentage of the total cost of the line, and the work progresses so rapidly that the inspection cost is small in proportion to the total cost.

The cost of engineering varies not only with the class of work but with the character of the design and execution. For instance, works may be built with little inspection, from crude designs prepared by unskillful engineers, with the result that the cost of works may be large although the percentage paid for engineering may be small. Works skillfully designed and efficiently constructed necessarily involve a larger cost for engineering, which should be recognized in any valuation when the works give evidence of such skill and efficiency.

The cost of engineering for additions and extensions of a property may be as large, or even a larger percentage of the total cost than for the original plant, but under a continuous system of regulation engineering for additions and extensions, if charged to current expenses, should not be included in the valuation.

It is sometimes suggested that no engineering charge should be made in connection with the acquisition of real estate, and there may be some cases where such a view would be substantially correct. It is frequently the case, however, especially where strips of land are to be acquired, that the engineering cost is as great as for other portions of the work.

The record of the cost of the Wachusett Reservoir, where the engineers had little to do with the acquisition of land other than to prepare the plans of the lands and to make appraisals of the mill property and water rights, amounted to about 3% of the total cost of the property acquired. The percentage would have been considerably larger if nearly all of the property had not been acquired by purchase and very little by condemnation proceedings.

The records of the New York Water-Works show that the engineering connected with the acquisition of land to the end of September, 1913, amounted to 1.87% of the total expenditures on land account and to about 3% of the awards to the owners of the property.

*General Expenses.*—Under the head of General Expenses are included all administrative, legal and other general expenses during the period of construction. Such expenses include general office rent, the salaries of the officers of the corporation and of the secretary, treasurer, legal advisers, clerks and others. Statistics showing the amount of such expenses in the case of corporations are not available to the Committee. The statistics of municipal public service properties throw some light upon the subject, although generally defective in that the offices are frequently in public buildings where no rent is charged and the financial and legal duties are performed to a large extent by those who receive salaries paid out of general funds.

On the Massachusetts Metropolitan Water-Works, the administrative and expert services, with a small portion of the legal services, amounted to 1.43% of the cost of the work, an unusually low figure, as there was very little litigation in connection with the work.

On the New York Water-Works the strictly administrative expenses to the end of September, 1913, were 1.12% of the total disbursements to that date, but in addition, advertising and the fees of special counsel and commissioners of appraisal to the end of 1912, all in connection with the acquisition of land, amounted to \$2 966 000, equivalent to 3.39% of the total disbursements to that date, making the total for general expenses, exclusive of police services, 4.51 per cent.

On the Boston subways the general expenses, as given by the accounts, have amounted to 3.42% of the total, but some items usually classed as general expenses were charged directly to the various sections of the work.

It should be remembered that in all the cases above cited, a part of

the general expenses have been paid out of general funds and are not included in the above percentages.

In modern works in populated sections of the country there is a strong tendency toward an increase in general expenses, owing to the greater attention paid to policing and sanitation where large bodies of men are employed.

On the Metropolitan Water-Works the charge for police services amounted to \$211 000 for works costing \$26 736 000, equal to 0.79 per cent.

On the New York Water-Works to the end of 1912, the total disbursements amounted to \$87 551 000, of which \$1 369 000 was for police, equal to 1.56% of the total.

The Committee believes that original conditions should be considered in determining the proper percentage for general expenses and that the allowance above suggested for police and sanitation should be included only when similar expenditures were actually made in the creation of the property under consideration.

*Contingencies.*—In making an estimate of the cost of a projected undertaking, the experienced engineer adopts a policy of liberality with the intention of reaching the probable actual cost of the proposed work, and even under such circumstances the actual cost is as likely to exceed as to run below the estimate.

This policy of liberality includes an addition to the computed theoretical or geometrical quantities in all cases where the actual quantities are likely to be greater, the adoption of liberal rather than minimum prices for the various items of work, and a further allowance for contingencies. If the plans are incomplete, so that many minor features are omitted, he properly adds more for omissions and contingencies than where the plans are in greater detail.

In the valuation of a public service property, the same ideas should be kept in view and the percentage or sum to be allowed for contingencies should be governed, to a considerable extent, by the completeness of the inventory and the amount already allowed for omissions, by the extent to which additions have been made to the computed theoretical quantities and by the degree of liberality of the prices affixed to the various items of the inventory, but in no case should the contingencies be omitted or reduced to a small figure. Large contingent expenses are necessarily incurred in practically all important public works. They may occur from very many causes, among which may be enumerated the failure of contractors and the cost and legal expenses incident thereto; to the delay of certain parts of the work caused by such failure; to injunctions or to the inability to obtain possession of land in due season, thereby necessitating the execution of such portions of the work under winter conditions or other adverse circumstances; to stringencies in the money market, causing a temporary



shortage of funds, and a consequent disorganization of the forces employed on the work; to protracted strikes; to the necessity of rebuilding parts of the work which have failed because of improper design or unforeseen causes; to making alterations found to be necessary or desirable after the work is built, to the slipping of earth or rock, and to making changes in plans which increase the cost of work.

Such contingent expenses as those above enumerated, with the exception of the last two, should be included as contingent expenses in any valuation of an existing property because the existence of the property does not give any clew to the amount of most of the contingent expenses involved in its creation.

There is another subject closely related to contingencies which may be classed as insurance or risk. For instance, if an owner of property is constructing a building he runs the risk that it may be burned. If a fire occurs when a building is nearly finished and the owner has to rebuild it, the cost of the completed structure, if he has no insurance, will be nearly that of two buildings. In estimating the reproduction cost of the building, only one building would appear on the inventory, but in estimating its value, there should be added to the reproduction cost of the single building as otherwise determined, the sum necessary to insure its whole value against fire, and this sum should be added whether the owner actually paid it to an insurance company for carrying the risk or whether he assumed the risk himself. Similarly any other property which involves risk during its construction and testing should have added a contingent sum representing what the cost of insurance would be were there insurance companies to insure against such risks.

It is seldom that a large public service property is examined that there is not a disclosure of some large expenditure for works which have been destroyed, reconstructed, or not used because of faulty design or construction. In some cases this is distinctly the result of negligence, but in a majority of cases such expenditures have taken place where the owners were not negligent in that they have taken due care in the selection of engineers to design and contractors to construct the works. They are the result of human fallibility.

Many examples of failures have been furnished by masonry dams. A considerable portion of the Quebec bridge failed while in process of construction; there was a great slip in the Necaxa Dam, one of the highest earth dams ever built, when it was far advanced toward completion; the Loetschberg tunnel in Switzerland encountered bad ground, which required the abandoning of the tunnel for about a mile and its relocation through another portion of the mountain; the change in plan of the new Croton Dam of the New York Water-Works involved an additional expense of more than \$1 000 000 for construction and interest. These are only a few instances of many

which might be cited. Such disastrous occurrences are not contemplated by engineers when they make a provision for contingencies in preliminary estimates of the cost of works, but it seems proper in the valuation of an existing property which has been completed and successfully tested to recognize that the owner has been required to assume the risk of accident and failure and should be compensated therefor by at least the amount which insurance companies would charge for taking such risks were they doing this kind of business. This feature may properly be included in the valuation by increasing the amount allowed for contingencies or for contingencies and risks.

*Interest and Taxes.*—Interest upon the capital invested in the plant up to the time when it is first operated and begins to have earning capacity is an unavoidable expense.

Under the most favorable conditions it is necessary to raise the money required for the construction of the work months in advance of its expenditure and in many cases the whole amount must be raised before beginning the work in order to insure against a suspension of operations with the large loss necessarily incident thereto.

The rate allowed for interest during construction should be the prevailing rate at the time of the valuation, having regard, however, to the variations in rate in different localities and the character of the property. The rate of interest on money required for the original plant will generally be larger than on that required for extensions and betterments as the corporation naturally has a stronger financial standing after it possesses a successful operating plant.

The amount to be allowed for taxes during construction must be determined largely on the basis of local tax rates and other local conditions and in this case, as in others relating to overhead charges, the original plant and subsequent additions should be treated separately.

#### DEVELOPMENT EXPENSES.

The Committee has used the term "Development Expenses" to cover the investment, after the original plant and from time to time the extensions of the plant are first operated, required to equal the difference between the actual return and a fair return on the fair value of the property.

The term "Development Expenses" as above defined is substantially synonymous with the term "Going Value" when the latter is defined, as it has been, as "the investment necessary to put the plant into successful operation and to create revenues that justify its construction", but "Going Value" has been given very different definitions by the Courts and others which make it inadvisable to use the term.

Good policy, both from the standpoint of the corporation and the rate-payer, requires reasonable rates for the service rendered during the first few years of the operation of the original plant, although

as a result there be a deficiency representing the difference between the amount actually earned and the amount which the corporation is entitled to receive under the basic principle that it is entitled to a fair return on the fair value of its property. This deficiency must, in justice to the corporation, be made up. The fairest, most practical and definite way of doing this is by including this accumulated deficiency of earnings in the cost of the property.

This method of treating development expenses is in accord with the decisions of some public service commissions which have carefully studied the question and it is upheld by many decisions of the Courts, although not in the most authoritative manner.

The above discussion relates to the original plant, which often is only a small part of the whole property. The same principles apply to additions to the plant, but the development expenses in connection with ordinary additions are very much less than those relating to the original plant.

After the property has begun to earn a proper return on the investment, minor additions can be made from time to time without interfering with a proper return on the whole investment so that there would be no charge to development expenses in connection with such minor additions.

On the other hand, extensions are frequently of such great magnitude that it is not feasible for a time to earn a proper return on the increased valuation due to them and development expenses accrue which should be treated as in the case of the original plant.

*Development Expenses of Losing Venture.*—It is sometimes argued that the method above described for determining the amount of development expenses is defective because when applied to a property that has not been able to earn a fair return upon what would with a normal plant be a fair value of its property, the amount allowed for development expenses would not only be much greater than for a normal property, but would continue to increase without limit.

The Committee has already suggested that many principles and methods applicable to a normal property are not applicable to a "losing venture". For instance, the "losing venture" is not entitled to what would otherwise be a fair return on the fair value of the property. It has to be recognized in such a case that the investor must accept the resulting losses and such rates as the services rendered are worth, and that the actual value of the property is necessarily based on the resulting earnings and not on other methods of valuation.

#### WORKING CAPITAL.

Working capital is essential to the proper operation of a public service property and should be included in the valuation upon which



fair returns are to be based. Any income upon the working capital coming from independent sources, such as bank interest, should be allowed for.

### DEPRECIATION.

*Fundamental Principles.*—The corporation, under normal conditions, in addition to an annual return for the use of its capital, is entitled, as already stated, to an allowance sufficient to provide for the net depreciation in the value of all the items of physical property, whether resulting from decay, wear and tear, or other cause, the amount of such depreciation allowance to be sufficient to amortize all such items of property by the time they cease to have value.

A depreciation allowance is, in effect, a payment from the rate-payer to the corporation of a part of its investment, and such part of the investment as has thus been repaid should not appear in subsequent valuations of the property.

The subject of depreciation necessarily deals with somewhat obscure changes which are taking place in the value of property all the time and with the changes which will take place in the future, so that the amount of depreciation actually accruing cannot be accurately determined.

Therefore it is necessary to adopt some practicable and equitable method of determining depreciation allowances which will meet the following requirements:

1. The method should be one which will insure, with as much certainty as possible, payments to the corporation sufficient to amortize the various items of property when they cease to have value.

2. It should so adjust the annual depreciation allowances as to distribute the burden as equally as practicable among the rate-payers of different years.

*An Existing View of Depreciation.*—There is no subject connected with valuation about which there are more diverse views than those relating to depreciation. Space will not permit the discussion of all of these, but there is one to which the Committee desires to call attention before making its own recommendation, namely: the view based upon railroad accounting and practice. From this point of view depreciation, instead of being a "lessening of worth" as defined by the dictionary, is not a lessening of worth for rate-making purposes if the property is kept up to 100% efficiency, although it is recognized that there is a lessening of worth for the purposes of sale, as an old car is not as valuable as a new one. The yearly amount which the corporation is entitled to earn from the rate-payers for depreciation is, with exceptions, the sum necessary for replacing items of property which have become worn out or obsolete, and it is commonly stated that the yearly depreciation is an "operating expense," while the Committee



has defined it in the previous section as "in effect a payment from the rate-payer to the corporation of a part of its investment."

The water-works engineer dealing with long-lived properties, which infrequently require replacement, but come to the end of their lives through inadequacy or obsolescence, recognizes that the allowance for depreciation, if equivalent only to the cost of replacements from year to year, would be wholly inadequate, that is to say, the total amount which would be received from replacements in the first twenty or thirty years would be very insignificant compared with the lessening of worth of the original items of property through the growing inadequacy of some and the tendency toward obsolescence of others.

Although the inadequacy of the depreciation allowances based on cost of replacements are so much more noticeable when applied to long-lived property, it is also true that they are inadequate when applied to railroad properties, although this feature has not been as fully recognized by railroad engineers as by others, on account of prevailing methods of accounting and habits of thought.

The Committee believes that its recommendation given below is equitable and practicable and that the method recommended may be applied to both long-lived and short-lived properties. If applied to railroad properties it will give a larger annual allowance for depreciation than is received under prevailing methods, and yet no more than the railroad or other public service corporation is entitled to.

*Equal-Annual-Payment Method.*—The Committee recommends for practical use what it calls the Equal-Annual-Payment Method of computing depreciation allowances. This method is based on the theory that the most practicable and equitable method is one in which the depreciation allowance for any given item of property is so adjusted that, taken in connection with the amount which the rate-payer must contribute on account of such item for a fair return on the investment and for repairs and operation, it shall be constant in each year of the life of such item.

In practice it is not feasible to comply exactly with the theory stated, but it can be so nearly complied with that the Committee has called the method which it recommends an Equal-Annual-Payment Method. This method and every other practicable method which aims to pay the investor the full amount of his investment in each item of property at the time it ceases to have value necessarily requires a determination of the expectation of life of such items.

In order to explain the Equal-Annual-Payment Method the accompanying illustrative table is presented, but the table takes into account only the two principal of the three factors above mentioned, namely: (a) the annual depreciation allowance, (b) the return for the use of capital, and omits (c) the minor effect of the cost of repairs and operation which will be referred to subsequently.

ILLUSTRATION OF EQUAL-ANNUAL-PAYMENT METHOD OF COMPUTING DEPRECIATION.

Assumptions: Property having 20-year Life valued when new at \$100.00. Computations of Depreciation Allowances based upon 5 per cent. Interest Compounded Annually. Annual Return on Capital Invested 5 and 7 per cent.

(1) Age, in years.	(2) Value at end of year.	(3) Deprecia- tion during year.	(4) RETURN ON REMAINING VALUE OF PROPERTY AT:		(5) COMBINED DEPRECIATION AND RETURN UPON INVESTMENT AT:	
			5%	7%	5%	7%
0	\$100.00					
1	96.98	\$3.02	\$5.00	\$7.00	\$8.02	\$10.02
2	93.80	3.18	4.84	6.79	8.02	9.97
3	90.47	3.33	4.69	6.57	8.02	9.90
4	86.97	3.50	4.52	6.33	8.02	9.83
5	83.29	3.68	4.34	6.08	8.02	9.76
6	79.43	3.86	4.16	5.83	8.02	9.69
7	75.38	4.05	3.97	5.56	8.02	9.61
8	71.12	4.26	3.76	5.27	8.02	9.53
9	66.65	4.47	3.55	4.98	8.02	9.45
10	61.96	4.69	3.33	4.67	8.02	9.36
11	57.03	4.93	3.09	4.33	8.02	9.26
12	51.86	5.17	2.85	3.99	8.02	9.16
13	46.43	5.43	2.59	3.63	8.02	9.06
14	40.73	5.70	2.32	3.25	8.02	8.95
15	34.74	5.99	2.03	2.85	8.02	8.84
16	28.45	6.29	1.73	2.43	8.02	8.72
17	21.85	6.60	1.42	1.99	8.02	8.59
18	14.92	6.93	1.09	1.53	8.02	8.46
19	7.64	7.28	0.74	1.04	8.02	8.32
20	0.00	7.64	0.38	0.53	8.02	8.17
		\$100.00				

The illustration is based upon an item of property valued when new at \$100 and having a twenty-year life. The depreciation during each year is based on interest at 5% per annum, compounded annually, and for purposes of illustration the annual return for the use of the capital invested is reckoned at both 5 and 7 per cent.

The depreciation during each year, as given in Column 3 of the table, is exactly the same as if computed by the so-called Sinking-Fund Method; that is, it is the constant annual payment to a sinking fund added to the year's interest on the accumulated fund at the beginning of the year.

When the annual return for the use of the capital invested is based upon the same percentage that is used in computing the depreciation, the method provides exactly the same total payments on account of depreciation and return combined as would be obtained by establishing a sinking fund which earned 5% interest, but it does not contemplate the maintenance of such a fund. Thus, at 5% the annual contribution to a sinking fund to wipe out \$100 of value in twenty years is \$3.02, which added to 5% of the \$100 originally invested in the item of property, gives a total of \$8.02 for each year.

It will be seen by reference to Column 6 of the table that \$8.02 is the combined annual depreciation and return for each year of the twenty by the proposed method, but this sum in the table is made up in a different way. The annual return, instead of being based upon the full value of the property, is based upon its net or depreciated value at the beginning of each year, as given in Column 2, such net value being obtained by subtracting successively the depreciation during each year. For example, the depreciation during the first year is \$3.02, which subtracted from the full value leaves \$96.98 as the depreciated value at the end of the first year; deducting from this figure the depreciation during the second year, amounting to \$3.18, leaves \$93.80 as the depreciated value at the end of the second year, and so on.

The return for the use of capital in the third year would be 5% on \$93.80 — the depreciated value at the beginning of the year — equal to \$4.69 as stated in Column 4, which, added to the \$3.33 for depreciation during the year, gives \$8.02, as stated in Column 6.

Although the Sinking-Fund and Equal-Annual-Payment Methods, under the assumptions made, provide for the same annual rates, there is a difference in the principle involved. The Sinking-Fund Method provides for a uniform annual payment to the sinking fund which must be invested and earn interest in order that the accumulations may amount to the full value of the item of property at the end of its life, while the yearly depreciation allowances by the Equal-Annual-Payment Method include sums equivalent to the interest in the Sinking-Fund Method and therefore amount without interest to such full value. Thus, referring to the third column of the table, the depreciation during the second year is \$3.18, which is equivalent to \$3.02, the depreciation during the first year with 5% interest added. The depreciation during the third year is \$3.33, equal to \$3.18 with 5% interest added, and the same rule applies to the end of the column.

The Equal-Annual-Payment Method distinguishes plainly between the return for use of capital, available for dividends, and the depreciation allowance which should be credited to the capital account; thus in the tenth year of the item of property illustrated in the table, the return available for dividends is \$3.09, as given in Column 4, while the depreciation allowance to be credited to capital is \$4.93, as given in Column 3.

The method is an advantageous one for valuing an old property because the rates remain the same regardless of the ages of the several items of property.

Attention may be called to another feature illustrated by the table. If the item of property having a twenty-year life has existed for say twelve years, its depreciated value at the end of the year, as given in Column 2, is \$51.86, and the depreciation allowance for the thirteenth year is \$5.43. This allowance is the same amount as an annual sinking-fund payment on a new item of property having a value of \$51.86 and a life of eight years.

The foregoing statements have been based on the use of 5% in all computations, but there are reasons, to be referred to subsequently, why the rate of return for the use of capital will generally be larger than the interest rate used in computing depreciation, and when there is such a difference in the rate, the combined annual depreciation and return for the use of capital, as given in Column 7 of the table, will not be strictly uniform from the beginning to the end of the twenty-year period.

It has already been stated that in preparing the table only two of the three factors were taken into account, and the introduction of the third factor—the cost of repairs and operation—will affect the degree of uniformity because as a rule such cost increases as the property grows older. The inclusion of such cost, therefore, will increase the quantities in Columns 6 and 7 to a greater extent in the later than in the earlier years, making the results based on Column 6 somewhat greater in the later than in the earlier years, and those based on Column 7, under most circumstances, more nearly uniform than they are in the table.

It is impracticable to devise any rule which will provide for strictly equal annual payments if the cost of repairs and operation is included, because while as a rule such cost is a small factor in the problem it is variable, and there are exceptional cases in which the cost of repairs and operation differs greatly from the beginning to the end of the life. Practically, however, the exceptional conditions mentioned are unimportant, because where the several items of property have different lives there will be a tendency to equalization of payment on account of the three items of return on capital, depreciation, and repairs and operation when the whole property is considered together.



*Rates of Interest and Return.*—It is the judgment of the Committee that a smaller percentage should be used for computing the annual depreciation allowances than would be a proper rate of return for the use of capital invested in public service properties.

In the past many of those who have discussed the subject, having in mind the creation of depreciation or sinking funds, have adopted a low rate of interest in making their computations of depreciation on the ground that funds safely invested would not give a net return of more than 3 or 4 per cent.

It is the view of the Committee that no such funds should be created, except temporarily, and that the rate of interest to be used in computing depreciation allowances should be substantially the rate at which the corporation can borrow money upon adequate security. In recent years this rate has been about 5 to 5½% for the average well-established corporation. To adopt a rate much above 5% for computing depreciation allowances would result in smaller allowances for depreciation in the early years of the life of each item of property, especially long-lived property, than the Committee believes to be advisable.

The rate of return upon the investment should be higher than that used in computing the depreciation allowance, so as to cover interest and profit, and thus give a return commensurate with the risks involved in such investments.

While, as stated above, well-established corporations have been able in recent years to borrow money at rates of 5 to 5½%, in practice not more than from one-half to three-quarters of the capital required can be raised at these rates, higher rates having to be paid upon the rest of the capital required by reason of the less adequate security.

*Investment of Money Received by the Corporation for Depreciation Allowances.*—Assuming the Committee's view to be correct, that a depreciation allowance is a return to the corporation of a part of its investment in existing items of property, the money so returned should be treated as a part of the capital and used for any purpose for which the corporation is authorized to use capital, namely: for additions, replacements, betterments, or the extinguishment of outstanding obligations.

It may happen that the amount earned for depreciation allowances will be in excess of immediate needs, and in such cases the accumulations become a part of the working capital until there is an opportunity to invest them in the property.

*Depreciation Allowances an Important Feature in Rate Regulation.*—In any equitable and comprehensive regulation of rates it is necessary that the amount of the depreciation allowances should be determined by logical and proper methods uniformly applied from year to year.

In the case of some properties made up of items which have a short life, like those of telephone companies, the amount which the corporation is entitled to earn for depreciation may be as great as the amount which it is entitled to earn as a return upon its capital.

Where the property is made up of long-lived items, as in the case of water-works property, the amount of the depreciation allowance is still important and should be carefully determined by public service commissions and engineers if justice is to be done to both the corporation and the rate-payer.

Depreciation allowances should be such that the corporation shall have received, when its property is worn out or become obsolete, neither 50 nor 150% of its value, but as nearly 100% as the best methods of determining the depreciation allowances will permit.

*Expectation of Life as a Basis for Estimating Depreciation.*—It is generally admitted that the owner of a public service property is entitled to earn annually a sufficient sum for depreciation to keep his investment unimpaired, and this view is supported by the Knoxville decision of the United States Supreme Court, which states that the company "is entitled to see that from earnings the value of the property invested is kept unimpaired, so that at the end of any given term of years, the original investment remains as it was at the beginning".

Notwithstanding the adoption of this view, many have objected strongly to using the expectation of life of the different items of property as a basis for determining the depreciation of such property, claiming, especially in the case of property subject to functional depreciation, that any attempt to estimate the probable life is purely guess-work.

There cannot be any doubt that many parts of a public service property which will not fail through wear and tear or decay are becoming less valuable each year because of approaching inadequacy or obsolescence, and it is the judgment of the Committee that the corporation is entitled to a depreciation allowance corresponding to the lessening worth of all its property. To omit functional depreciation would not, under the present rulings of the Courts, do justice to the corporation, because if the full value of the property has not been returned in the form of depreciation allowances while the property is in use, it will afterward be excluded from the valuation as unused and obsolete property.

In other words, the corporation should receive the whole 100% of the value of an item of property during its lifetime because there is little likelihood that it will receive any subsequent allowance on account of such property, and this can be done only on the basis of the expectation of life of all items of property.

It is not claimed that one can determine accurately the life of any given structure or item of property, but that if experience is used as a guide, inaccuracies in such determination will, to a considerable extent, balance one another so as to give a fairly correct result in regard to the plant as a whole.

It is obvious that precision cannot be attained when one is dealing with the future, but in the judgment of the Committee a greater degree of precision can be attained by a method which deals with the expectation of life of items of property than in any other way.

The statistics of the actual life of public service property of a permanent character gathered by the Committee, show that such actual life is much shorter than the estimates generally given in publications on the valuation of public utilities, and probably much shorter than the builders of the structures anticipated. Changes which cannot be foreseen are taking place all the time, and the life assigned to the various items of property should be based largely on experience rather than on optimistic views of the future.

*Sinking-Fund Method.*—The Sinking-Fund Method of computing depreciation allowances, as already stated, gives the same results as the Equal-Annual-Payment Method, but the use of the words Sinking Fund appears to have misled some Courts and commissions so that they have objected to the depreciation allowances so computed on the ground that the method involved the creation of a sinking fund to be kept intact until the replacement of the property at a later time. (See Decisions of Courts and Commissions in Regard to Depreciation.)

*Straight-Line Method.*—The Straight-Line Method of computing depreciation assumes that the value of the item of property under consideration decreases an equal amount in each year of its life; that is, the depreciation in each year is the full value of the property divided by the number of years of its life. The method is simple and may appear to some to provide for equal annual payments by the rate-payers, but instead it requires a much larger payment in the earlier years of the life of the item of property than in the later years, as will be seen by the illustration furnished by the table on page 40.

This table differs from the preceding one on page 34 only in the method adopted for determining the amount of depreciation. Columns 6 and 7 in both of these tables are representative of the rates which the public should pay as determined by the two methods. In the former table, based upon the Equal-Annual-Payment Method, the rates are nearly equal in each of the 20 years, while in the latter table, based upon the Straight-Line Method, they are about twice as large when the property is new as in the last year of its life.

This illustration shows that in the case of those properties, consisting largely of long-lived items, upon which the annual cost of repairs is not much greater in the later than in the earlier years of

## ILLUSTRATION OF STRAIGHT-LINE METHOD OF COMPUTING DEPRECIATION.

Assumptions: Property having 20-year Life, valued when new at \$100.00. Annual return on Capital Invested, 5 and 7 per cent.

(1) Age, in years.	(2) Value at end of year.	(3) Depreciation during year.	(4) RETURN ON REMAINING VALUE OF PROPERTY AT:		(6) COMBINED DEPRECIATION AND RETURN UPON INVESTMENT AT:		(7)
			5%	7%	5%	7%	
0.....	\$100.00						
1.....	95.00	\$5.00	\$5.00	\$7.00	\$10.00	\$12.00	
2.....	90.00	5.00	4.75	6.65	9.75	11.65	
3.....	85.00	5.00	4.50	6.30	9.50	11.30	
4.....	80.00	5.00	4.25	5.95	9.25	10.95	
5.....	75.00	5.00	4.00	5.60	9.00	10.60	
6.....	70.00	5.00	3.75	5.25	8.75	10.25	
7.....	65.00	5.00	3.50	4.90	8.50	9.90	
8.....	60.00	5.00	3.25	4.55	8.25	9.55	
9.....	55.00	5.00	3.00	4.20	8.00	9.20	
10.....	50.00	5.00	2.75	3.85	7.75	8.85	
11.....	45.00	5.00	2.50	3.50	7.50	8.50	
12.....	40.00	5.00	2.25	3.15	7.25	8.15	
13.....	35.00	5.00	2.00	2.80	7.00	7.80	
14.....	30.00	5.00	1.75	2.45	6.75	7.45	
15.....	25.00	5.00	1.50	2.10	6.50	7.10	
16.....	20.00	5.00	1.25	1.75	6.25	6.75	
17.....	15.00	5.00	1.00	1.40	6.00	6.40	
18.....	10.00	5.00	0.75	1.05	5.75	6.05	
19.....	5.00	5.00	0.50	0.70	5.50	5.70	
20.....	0.00	5.00	0.25	0.35	5.25	5.35	
		\$100.00					

life, the Straight-Line Method is undesirable for the following reasons:

1. That it is inequitable as it makes a much greater demand on the rate-payers of the earlier years than on those of later years.

2. That it permits the corporation to earn for depreciation in the earlier years a larger sum than is necessary to maintain the full value of its investment.



3. The method requires higher rates during the early part of the life of a property when it is more difficult to pay such rates than in the later years.

The objections to this method are less in the case of short-lived property, as will be seen by the following illustration based on 10- and 40-year life, respectively, instead of 20. A 7% annual return has been assumed and the results are comparable with those in Column 7 of the table on page 40.

	10-Year Life.	40-Year Life.
First-year rates,	17.00	9.50
Last-year rates,	10.70	2.67

*Actual-Inspection Method.*—In the valuation of property the amount of depreciation has frequently been determined without reference to any fixed rule, the appraiser inspecting the property and using his judgment as to the amount of depreciation. In such cases the judgment is often based almost wholly upon the observed physical depreciation of the property. Earthwork, substantial masonry, and other property in excellent condition are appraised at or near their full value. Such appraisals are likely to result in a much smaller total depreciation in the value of the property than when based upon the expectation of life of the different items of such property and, as a consequence, would logically entitle the corporation to a much smaller annual allowance for depreciation than when a method is used which includes depreciation of all kinds.

Under such a method many items of property would become obsolete before the corporation had received an amount for depreciation approximating 100% of their value.

There is a fundamental objection to depending upon the personal judgment of appraisers, as this method determines only the total depreciation of the property and not the amount of the depreciation allowance which the corporation is entitled to earn, unless it is to be assumed that the difference in the amount at which the property is appraised from time to time furnishes a measure of the amount of depreciation which should be allowed during the period between such appraisals. It is obvious that very erratic results would be obtained by such a method, especially if different persons acted as appraisers in different years.

This method does not take account, to any considerable extent, of functional depreciation, and the great injustice which may be done a corporation by the failure to take such depreciation into account has already been stated.

It is not intended by this condemnation of the Actual-Inspection Method to indicate that there should not be an actual inspection of all property in connection with other methods of determining the amount of depreciation. Such inspection should be made partly for the pur-

pose of noting the condition of the property and partly for the purpose of determining the probable future life of the various items of property.

*Replacement Method.*—It has sometimes been claimed that, when a property is maintained in good condition by repairs and by making replacements when necessary, rates should be based upon the full value of the property. Under this theory, the corporation would be entitled to earn as a depreciation allowance the amount actually expended for replacements. With an unregulated and short-lived property, this method has in the past produced fairly satisfactory results when a property has been maintained in excellent condition by charging many betterments as well as replacements to current expenses. It has no place in any proper theory of rate regulation, especially in the case of long-lived property, as great injustice may be done by the application of the method. It holds back from the corporation an annual sum for depreciation which the United States Supreme Court in its Knoxville decision says the corporation is entitled to earn to keep the value of the property unimpaired. If the money justly due the corporation annually is not then paid it is not likely that it will be paid subsequently.

*Application of Equal-Annual-Payment Method.*—In a strict sense, the term "item of property" which has been frequently used in this report may be so defined as to cover insignificant items, such as, for instance, small tools which may have a life of one, two, or three years.

It is obviously impracticable in any system of accounts to consider the depreciation from year to year of such short-lived property, and its cost should be considered a part of the current expenses, except in cases where a temporary charge is made to the account of stock on hand.

In determining the expectation of life of a given item of property, one necessarily deals with such item taken as a whole. For instance, a wooden building may be assumed to have a life of thirty years. During its life it is necessary many times to replace the paint. Such replacements during the life of a building are not taken care of in the depreciation allowance herein recommended and should be charged to current expenses. The same rule applies in a multitude of cases, such as the replacement of bolts in a railroad track, the renewal of parts of locomotives or pumping engines, the placing of additional ballast on a railway road-bed, and to much greater expenditures, as for instance, the replacements of parts of road-beds or machines after wash-outs or accidents.

Should the method herein recommended of providing for depreciation be adopted, the decision as to where the line shall be drawn between the low cost and shorter lived items of property on the one hand—the depreciation of which can best be taken care of by charging the cost of replacements to current expenses—and the high cost and

longer lived items of property on the other hand—the depreciation of which can best be taken care of on the basis of the expectation of life—may well be left to the Public Service Commissions and others having charge of the valuation of the different kinds of public service property.

As a general statement, it may be said that the basis of expectation of life should be used for all important items of property having a life of more than, say, five years, except where it may involve unwarranted expense for accounting or be impracticable to separate what would properly be, under the Equal-Annual-Payment Method, charges to current expenses and to capital. For instance, it would not be practicable to separate the charges for labor for tamping railroad ties that are renewed from that for tamping ties already in use, although if it were desired to avoid entirely the use of the replacement method of determining depreciation, it would be feasible to estimate what part of the total yearly charge for such tamping is attributable to the work on new ties and therefore properly chargeable under the Equal-Annual-Payment Method to capital, and to transfer the estimated sum annually from the operating to the capital account.

Under a continuous system of accounting small items of property purchased and charged directly to current expenses should obviously not be included in the valuation of the property upon which the annual return is to be based.

*Grouping Items of Property.*—In many cases where a valuation is made, there are certain kinds of property, such as cars, rails, ties, telephones and telephone poles, which exist in large numbers and are of all ages; these can be dealt with by grouping them.

If there be a group consisting of a large number of items, each having the same expectation of life and existing in equal numbers of each age, the annual depreciation allowance for the group, whether computed by the Straight-Line Method or the Equal-Annual-Payment Method, would be the same. There is, however, a difference in the average remaining value of such a group of items on which the annual return is to be made. If the Straight-Line Method be applied on the basis adopted in computing the table on page 40, using the value at the beginning of a year as the basis for computing the return, the average remaining value will be 52.5% of the value new, while if the Equal-Annual-Payment Method be applied on the basis adopted for computing the table on page 34, the average remaining value will be 60.5 per cent. If instead of computing the return upon the remaining value at the beginning of each year it were computed upon such value at the middle of each year, the average remaining values would be, respectively, 50 and 57.6 per cent.

*Scrap Value.*—All of the foregoing statements regarding depreciation relate to property which has a negligible scrap value. In the case of items of property like steel rails, which have a large scrap value, the



statements are not strictly applicable, but the same general principles are involved; the amount of depreciation to be provided for being the difference between the new and the scrap value.

*Decisions of Courts and Commissions in Regard to Depreciation.*—There were some Court decisions made from ten to twenty years ago rejecting the claims of corporations for annual allowances for depreciation. The decision of the United States Supreme Court in the Knoxville case, in 1909, states clearly, however, that the corporation is entitled to earn an annual depreciation allowance, and that the return should be based on the depreciated value of the property. This decision has been upheld by many subsequent decisions of the same Court.

The portion of the decision relating to depreciation is as follows:\*

“The cost of reproduction is one way of ascertaining the present value of a plant like that of a water company, but that test would lead to obviously incorrect results if the cost of reproduction is not diminished by the depreciation which has come from age and use.”

“The cost of reproduction is not always a fair measure of the present value of a plant which has been in use for many years. The items composing the plant depreciate in value from year to year in a varying degree. Some pieces of property, like real estate for instance, depreciate not at all, and sometimes, on the other hand, appreciate in value. But the reservoirs, the mains, the service pipes, structures upon real estate, standpipes, pumps, boilers, meters, tools and appliances of every kind begin to depreciate with more or less rapidity from the moment of their first use. It is not easy to fix at any given time the amount of depreciation of a plant whose component parts are of different ages, with different expectations of life. But it is clear that some substantial allowance for depreciation ought to have been made in this case.”

“A water plant, with all its additions, begins to depreciate in value from the moment of its use. \* \* \* the company is entitled to earn a sufficient sum annually to provide not only for current repairs, but for making good the depreciation and replacing the parts of the property when they come to the end of their life. The company is not bound to see its property gradually waste, without making provision out of earnings for its replacement. It is entitled to see that from earnings the value of the property invested is kept unimpaired, so that, at the end of any given term of years, the original investment remains as it was at the beginning.”

“If, however, a company fails to perform this plain duty and to exact sufficient returns to keep the investment unimpaired, whether this is the result of unwarranted dividends upon over issues of securities, or of omissions to exact proper prices for the output, the fault is its own. When, therefore, a public regulation of its prices comes under question, the true value of the property then employed for the purpose of earning a return cannot be enhanced by a consideration of the errors in management which have been committed in the past.”

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\* Knoxville v. Knoxville Water Co., 212 U. S., 1, January 4, 1909.



The Equal-Annual-Payment Method accords with the principles laid down in this decision, while any method which does not make provision for depreciation as it accrues would not be in accord with such principles. In this case the Court was dealing with an established normal plant. It cannot be supposed that the same reasoning would be applied to a new plant unable in its early years to earn a sufficient sum to cover depreciation nor to one which immediately after important additions had been made was temporarily unable to earn such sufficient sum. In the judgment of the Committee the decision of the Court in the Knoxville case with regard to depreciation is equitable.

Except for the basic principles laid down in the Knoxville decision, the decisions of Courts and commissions in regard to depreciation have been very variable. The Straight-Line Method has been used and Courts have approved valuations in which the depreciation has been computed by this method. They have, however, more often approved valuations in which the sinking fund, or as the Committee has termed it, the Equal-Annual-Payment Method, has been used.

In some cases where both the Straight-Line and the Sinking-Fund Methods have been presented, the Sinking-Fund Method has been rejected, but this appears to have been the result of the assumption that the Sinking-Fund Method, instead of being a practical method for fixing the rate of depreciation, is a method for creating a sinking fund to pay for the replacement of the plant at a later date.

For instance, in the Louisville, Ky., telephone rate case, District Judge Evans, in fixing the annual depreciation allowance makes this statement:\*

"Of course our estimate could not be based upon the proposition that the per centum set apart to cover depreciation would be deposited in bank or loaned out from year to year so as to accumulate and be on hand at the end of 14 years, and to be then used to construct an entirely new plant, and so on from period to period. In such a case the public would not only have a service that would progressively grow worse until its operations ceased altogether, but it would thereafter get no service at all until a new plant replacing the old could be completed and put into operation. The question rather has been, What does experience show to be the proper average per cent. of annual earnings which the company should expend in order to insure that its plant at the end of 14 years will be as good as it now is, and in the meantime render to the public that good service which its duty to the public requires?"

There was a decision against a Sinking-Fund Method in a New York tax case in 1911. In this case, Judge Gray of the New York Court of Appeals states (at page 235):†

"The courts below determined that the relator was entitled to make annual depreciation charges, amounting in the case of the borough

\* *Cumberland Telephone and Telegraph Co. v. City of Louisville*, 187 Fed., 637, April 25, 1911.

† *People ex rel. Manhattan Railway Company v. Woodbury*, 203 N. Y., 231, October 17, 1911.

of Manhattan to the sum of \$360 613.65 and in the case of the borough of The Bronx to the sum of \$37 435.67, for the purpose of creating a fund to provide for the depreciation of its various properties; upon which interest at four per cent., compounded, would produce a sum, at the termination of the ascertained physical life of the several classes of property, equal to the cost of the particular property. While I am, personally, of the opinion that the creation of such an amortization fund furnishes the best rule for adoption in such a case as this, in working out the value of special franchises, the majority of my brethren entertain a different view. They think that the annual allowance for depreciation should be computed by dividing the values of the various kinds of tangible property by the number of years of their respective estimated physical lives and that will be the opinion of the court."

Judge Haight, of the same Court, in a concurring opinion, objects to the Sinking-Fund plan as follows (at page 239):\*

"The Special Term in this case, however, adopted a plan of amortization upon which an annual sum was authorized to be set apart as a sinking fund, which, by compounding the interest thereon for a period equal to the life of the structure, tracks, engines, machinery and rolling stock, would at the end of that period create a fund sufficient to replace the property. The difficulty with such holding is that railroad corporations do not reconstruct their railroads and rolling stock in that way. In order to afford proper protection to the public they are required to maintain a high state of efficiency both in road-bed and rolling stock. The relator's railroad has been in existence already for about thirty years and some portion of its property has already suffered from decay and use to such an extent that portions thereof have to be reconstructed and made new each year. Old ties have to be removed and replaced with new ones; old rails that have become worn and battered have to be removed and their places supplied with new rails and so the work of reconstruction progresses from year to year. It is not the waiting forty or sixty years to reconstruct, during which time the amount set apart as a sinking fund may be doubled many times over by compounding the interest, but it is the annual expenditure for reconstruction which is to be paid for at the time that the construction is made. To illustrate: Suppose the average life of the tangible property of a railroad, outside of the land itself, to be sixty years and the cost of reconstruction to be sixty million dollars, it would follow that one million dollars would have to be used each year in reconstruction, and that amount would have to be annually used for that purpose; but under the plan adopted in this case, instead of deducting from the gross earnings the amount necessarily expended for that purpose, a small fraction of that sum, viz., \$4 200, only is allowed to be deducted, a sum which, with the interest compounded for the next sixty years, would amount to a million dollars. Under such a plan the company would be practically prohibited from annually constructing a portion of its road and thus prevented from keeping it in that state of efficiency which the public demands. Of course the necessities of reconstruction vary from year to year;

\* *People ex rel. Manhattan Railway Company v. Woodbury*, 203 N. Y., 231, October 17, 1911.

some years it may be greater than others, but the assessors each year can easily ascertain the sum required for that purpose. I think, therefore, that we should adhere to the rule sanctioned in the *Jamaica* case, and that a gross sum should be deducted annually for the purposes of reconstruction."

It seems clear that in these opinions the opposition to the Sinking-Fund Method is directed against the establishing of a sinking fund to be kept intact for a long series of years, and not against the method on account of its providing for uniform annual payments.

The illustration given in Judge Haight's concurring opinion seems to indicate that he thought the Sinking-Fund Method would give an annual allowance for depreciation of only a small fraction of the sum determined by the Straight-Line Method. The property in question was that of the Manhattan Railway Company, and in view of the age of the structures and the varying ages of the equipment, it seems not unlikely that the annual allowance for depreciation would have been as great by the Sinking-Fund as by the Straight-Line Method of measuring depreciation.

The Sinking-Fund Method of measuring depreciation has been approved by the Wisconsin Railroad Commission and has been rejected by the New York Public Service Commission, First District. The decision in the latter case is open to about the same comment as the decision in the above cited Court cases, as will be seen by the following quotation (page 347, Whitten):

"Without going into the technical details of these two plans, suffice it to say that the fundamental difference is that the former [Straight-Line Method] assumes the property to decrease uniformly in value from year to year, the latter [Sinking-Fund Method] that it follows a parabolic curve. The former assumes that the decrease will be met year by year as it occurs, that the payment from earnings will be immediately expended and that it will not accumulate at compound interest. The latter assumes that nothing will be spent before the end of the period, that it will all accumulate and that impairment of capital need not necessarily be met as it occurs."

There are other decisions relating to physical and functional depreciation which do not accord with one another. Upon the whole, it may be said that the Court and commission decisions have not reached that degree of definiteness which will prevent the application of the method herein recommended.

*A Fallacy in the Discussion of Depreciation.*—At the risk of repeating what has already been stated, the Committee will refer again to the fallacy of the view expressed by engineers of much experience in valuation, that rates based upon the depreciated value of a property are necessarily lower than those based upon its full value.

A recent work on Valuation\* gives these illustrations (pages 207-208):

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\* "Valuation of Public Utility Properties," by Henry Floy, New York, 1912.



"Assume that the life of a large part of a complete property is 20 years, then at the end of 19 years and 6 months, if theoretical depreciation is considered, the present value of the property would be small and the rates based thereon would include nothing in the way of return on the large part of the property, still 100 per cent. useful, a year thereafter the property being entirely replaced and new, the rates would be incomparably higher."

"Consider two surface railways running out parallel avenues from the center of a city to the suburbs, both alike in construction, but one 10 years old and the other put in operation within a year. If theoretical depreciation is considered the present values of these two properties are quite different, the older road being worth appreciably less than the new road, although the original cost of installation may have been the same in both cases. Under such circumstances, is the older road to be allowed to charge only a four-cent fare, assuming that that gives a fair return on the estimated present value, while the new road must charge a five-cent fare for the same return on its estimated value? What would be the result practically of such method of fixing rates? The old road would be swamped with business and the new road would be unable to maintain its earnings."

The "theoretical depreciation" referred to in these quotations is the depreciation based upon the length of life of the property. It has already been shown in this report that the life of the property used in connection with the Equal-Annual-Payment Method of determining depreciation allowances results in practically uniform rates whether the property be old or new. There is, therefore, no logical ground for the statements above quoted or for the following quotation based upon them:

"Can such fanciful and variable bases be intended by the Supreme Court to be taken as that on which rates are to be estimated and regulated? Such conclusion would be illogical, unreasonable and unfair."

In the recent discussion\* of the paper on the "Physical Valuation of Railroads," by William J. Wilgus, M. Am. Soc. C. E., not only have several of those taking part in the discussion favored the use of the full value of a property as the basis for rates, but some have endorsed the above mentioned fallacy. One writer says:

"A new public utility company starting to-day would be entitled to a fair return on its actual investment, and it would lead to 'confusion worse confounded' were a part of that investment 'written off' each year because of depreciation. The thing could be done, but no useful purpose would be served by doing it, while, on the contrary, rates of charge for service would fluctuate with an ever-changing depreciated value. There is a good deal of 'horse-sense' in the illustration used by an attorney who argued that the price of milk is not a function of the age of the cow, growing less as the cow grows older,

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\* *Proceedings of the American Society of Civil Engineers*, October, 1913.



until it would be almost given away in the latter days of the cow's life. What the provident owner of a cow does is to charge a price for milk which will give a fair return on the investment (not on the depreciated value) plus enough to cover 'operating expenses,' including depreciation."

Another writer says:

"In the case of a public utility, adequately maintained and rendering efficient service to the public, to deduct for accrued depreciation according to the practice of some of our theorists, necessarily results in confiscation of investment.

"Certain appraisers of reputation have taken the ground that if, for instance, railroad ties have an effective life of 10 years, and one-tenth of the total number is renewed each year, there is no need for a depreciation reserve, but the value of these ties as a whole should be depreciated 50 per cent. Nothing, according to the writer's way of thinking, could be more fallacious. The property, as far as this item is concerned, is thus maintained at maximum efficiency. What more could be done? Why then should one-half of this portion of the investment be confiscated?"

It will be observed that the writers in all these cases ignore the fact that a depreciation allowance earned from the rate-payers is a return of a part of the investment, and that after that part of the investment is returned, it is neither inequitable nor confiscatory to base future returns upon the depreciated value, which is the remaining investment in the property. They also erroneously assume that the rates necessarily decrease when the depreciated value is used.

It is true that of the return on a given item of property, the part applicable to dividends becomes less as the property grows older, but this is as it should be; a part of the capital invested in that item has been returned and has either been invested in additions or replacements, or temporarily in a depreciation fund, so that the whole of the original investment is at all times earning returns applicable to dividends.

*Past Practice has Underestimated Depreciation.*—Ideas in regard to depreciation have in the past been based very largely upon practical methods of railroad accounting and not upon a consideration of the fundamental principles upon which depreciation allowances should be based, and even where the proper principles have been taken into account, the tables prepared by engineers of the expectation of life of different components of public service works have been based mainly upon physical depreciation, without making due allowance for the shortening of life caused by inadequacy and obsolescence.

Your Committee believes that there have been many cases in the past in which the annual allowances for depreciation have been underestimated, and that consequently engineers, public service commissioners and the Courts should give especial attention to the amount

of the annual depreciation allowances, so as to make them conform more nearly with the facts.

The inter-relation in rate-making cases between the annual depreciation allowance and the depreciated value of the property should never be lost sight of.

#### APPRECIATION.

The valuation of some items of property, such as land and water rights, differs from the valuation of other property in several respects. Land in most situations increases in value from year to year, especially in growing cities. Terminal land of railroads and land of other public service corporations sometimes increase in value so rapidly that the question arises as to the justice of basing rates upon the present value of the land rather than its original cost.

Your Committee is aware that the decisions of the higher Courts indicate that present prices should be used in making a valuation of land as well as of structural property, and that the present practice generally gives to the corporation as to the individual the so-called unearned increment due to appreciation in land values.

This is incompatible with the fundamental principle that the corporation is entitled to a fair return upon the fair value of its property, because, if the land is valued at the increased price, and the appreciation in the value of the land is not included in the accounting, the corporation would receive a sum in addition to a fair return amounting to the appreciation in the value of the land.

The Courts have recognized that the corporation is entitled to earn from the public the sum necessary to offset the depreciation in the value of its structural property; similarly, the public is entitled to receive from the corporation due recognition of the increase in value of those portions of its property which appreciate in value. The principle involved in the two cases is the same, and there is no reason to think that its application to both would not be supported by the higher Courts.

Your Committee therefore recommends as the best way of conforming to the equities of the case under commission control, that the land or other property which appreciates in value be valued at present prices, and that the appreciation in the value of such property be offset against the depreciation in the value of the other property. This method would keep the valuation of the land or other appreciating property approximately commensurate with its market value from time to time, and the corporation, having in effect paid to the public the amount of the appreciation, would thereafter be entitled to earn a fair return on the appreciated value of the property in exactly the same way that, having been paid by the public the amount of the annual depreciation of the other property, the corpora-

tion must accept a return upon the depreciated value of such property.

Attention is called to a very clear discussion of this question by Commissioner Maltbie of the New York Public Service Commission for the First District, *in re* Gas and Electric Rates of the Queens Borough Gas and Electric Company.\*

"Land differs from most property in that it generally appreciates in value, and the question has been raised, whether land should be included in 'fair value' in rate cases at its original cost or at its estimated value at the time the rate is to be fixed. It is well settled that other property should be taken at its *then* value, but it has been argued that in the case of land the original cost should be used. While it is evident, therefore, that each case must be decided upon the facts peculiar to it, the Commission believes it proper in this case to follow the general rule, as stated by Judge Hough of the United States Circuit Court (*Consolidated Gas Co. v. City of New York*, 157 Fed. Rep., 855):

"Upon reason, it seems clear that in solving this equation the plus and minus quantities should be equally considered, and appreciation and depreciation treated alike. Nor can I conceive of a case to which this procedure is more appropriate than the one at bar."

"Thus, land has been taken at its fair value and not at its original cost, and the annual appreciation of land has been treated as a profit. By this method, all property is treated absolutely alike, as Judge Hough suggests. No difference is made, except that as depreciation represents a decrease in assets, it is placed as a *debit* against operation, while appreciation is placed as *credit* because it is an increase in assets. Land has sometimes been treated like other property only to a degree; that is, each class has been appraised at its present worth or value. That has been done in this case. But if property is to be taken at its *depreciated* value where it has depreciated, an entry must regularly be made in estimated operating expenses equal to the average annual depreciation. Conversely, if land, or any other property which genuinely appreciates in value, is to be taken at its *appreciated* value, then an entry must be made in the estimated receipts equal to the average annual appreciation. Unless this is done, it is obvious that the consumer will be burdened with all the estimated decreases in assets but not credited with the increases in assets. If the principle laid down by the courts is to be followed in part, it should be followed in whole.

"It is suggested that the annual increase in the value of land which is treated as income is not actually received. Increase in the value of unoccupied land is not realized until sold or put into use, but it is real, nevertheless, although payment may be deferred. Likewise, payments to the depreciation fund are not actually expended; yet they have been considered legitimate charges in practically every case. Furthermore, the *annual* increment is no more indefinite than the *total* increment—the present value. But if the present value can be determined, it is possible to determine past *annual* appreciation with positive accuracy, for it is only a simple mathematical calculation. It is also probably as easy to estimate increases in the near future



as it is to estimate what obsolescence, which is a form of depreciation, there will be in the future.

"Indeed, the problem of handling appreciation is much simpler than depreciation. If the property is growing more valuable, the investor need not worry; and if the state recognizes his right to earn a fair return upon the increase, he is fully protected. It is not necessary that the increase be represented by stocks or bonds, for if the earning power is there, he will receive a return thereon, regardless of the amount of securities. In fact, the existence of an increase which is not represented by securities is an element of safety, a reserve fund of a valuable kind.

"There is a further similarity. The exact amount of depreciation and the annual rate are not definitely known until the piece of property is actually replaced or has become useless. The total appreciation and the average annual rate are not known until the land is sold, but when it has been disposed of (and plants are continually being removed and the land sold), they become absolute certainties. Why should these matters be considered less definite when applied to land than when applied to the buildings thereon? The depreciation of the buildings is a charge against operation; why should not the appreciation of land be a credit?"

#### METHOD OF VALUING LAND.

It is more difficult to appraise correctly public service land than to appraise the structural property, as the views of different appraisers of land vary widely. For this reason and because of the decisions of the Courts on these matters, to be discussed subsequently, it is the view of the Committee that in cases where land has been purchased in fairly recent times, and its cost is known, that the present value of the land should be based upon its actual cost plus its subsequent appreciation in value, such appreciation to correspond to that of neighboring property.

Where the valuation cannot be made in this way, it is the view of the Committee that land can be valued most correctly on the basis of present prices of neighboring land of similar character, augmented by the ratio ordinarily found to obtain in that region between land acquired by public service corporations, on the one hand, and by private parties on the other, and subject to the value of improvements upon the land obtaining at the time of purchase, said improvements being appraised at their present day prices.

Due consideration also should be given to the increased cost and value of public service property where it has been necessary to take a strip of land running through a large tract. In such a case the severance of the property into two parts decreases the value of the land not taken and, therefore, augments the cost and value of the strip of land acquired.

In applying either of the above methods, care should be taken to use, as far as practicable, as a basis for valuation, land which has



not been affected in value by the use to which the public service property is devoted.

*Decisions of Courts and Commissions Relating to Land.*—In the valuation of land, Courts and commissions have generally adopted present values instead of original cost.

The decision of the United States Supreme Court in the Consolidated Gas Co. case\* contains this statement:

“And we concur with the court below in holding that the value of the property is to be determined as of the time when the inquiry is made regarding the rates. If the property which legally enters into the consideration of the question of rates has increased in value since it was acquired, the company is entitled to the benefit of such increase. This is, at any rate, the general rule. We do not say there may not possibly be an exception to it where the property may have increased so enormously in value as to render a rate permitting a reasonable return upon such increased value unjust to the public. How such facts should be treated is not a question now before us, as this case does not present it.”

In the case referred to, real estate was an important item, as it represented upward of 40% of the value of the tangible property.

On June 9th, 1913, the opinion† of the United States Supreme Court in the Minnesota Rate cases was delivered by Mr. Justice Hughes. This opinion, in its treatment of land values of a railroad corporation, is so far-reaching and important that it will be discussed at length.

Three similar cases are included in the opinion. The suits were brought by stockholders of the Northern Pacific Railway Company and of two other companies, respectively, to restrain the enforcement of orders of the Railroad and Warehouse Commission of the State of Minnesota prescribing maximum charges for the transportation of freight and passengers. The cases had been heard before a Master and decided by the United States Circuit Court in favor of the railroads. They were appealed to the Supreme Court and the decision of the Circuit Court reversed in two instances. In the third instance it was sustained on the ground that the prescribed rates were confiscatory. The case of the stockholders against the Northern Pacific Railway Company was used as the basis for the extended discussion of land values.

The lower Court found that the value of the portion of the railway system in the State of Minnesota was, in round numbers, \$90 000 000, and in making up this valuation, land for right of way, yards and terminals was included at \$21 000 000, exclusive of overhead charges.

\* *Wilcox v. Consolidated Gas Co.*, 212 U. S., 19, January 4, 1909.

† *Simpson et al. v. Shepard*; *Same v. Kennedy*; *Same v. Shillaber*. 230 U. S., 352, June 9, 1913. This opinion has also been published as Senate Document No. 54, 63d Cong. First Sess.

The net profits of the company for the year ending June 30th, 1908, were equal to 6% on the entire estimated value of the property.

A very large part of the land valued was terminal property in St. Paul, Minneapolis, and Duluth, the total for these terminals amounting to \$17 300 000, out of the total of \$21 000 000. The original cost of the terminal property was \$4 500 000.

The testimony upon which the valuation of the land was based was to the effect that experience had shown that where a railroad company is compelled to obtain a given property it has to pay much more than the market value of contiguous or similarly situated property, and a witness used a multiple to show the relation between these values. In addition, where a strip or other portion of a property is required, the railway company has necessarily to pay for damages to the remaining property, caused by severance or otherwise, and a further multiple was used to cover this feature.

The Court was dealing with property which as a whole had increased greatly in value since its acquisition and probably with widely conflicting estimates of value.\* Terminal lands in large cities represented by far the greater part of the total value of the property. This statement is made in the opinion in regard to the Cost-of-Reproduction Method of valuing this property (page 452):

"Moreover, it is manifest that an attempt to estimate what would be the actual cost of acquiring the right of way, if the railroad were not there, is to indulge in mere speculation. The railroad has long been established; to it have been linked the activities of agriculture, industry and trade. Communities have long been dependent upon its service, and their growth and development have been conditioned upon the facilities it has provided. The uses of property in the communities which it serves are to a large degree determined by it. The values of property along its line largely depend upon its existence. It is an integral part of the communal life. The assumption of its non-existence, and at the same time that the values that rest upon it remain unchanged, is impossible and can not be entertained. The conditions of ownership of the property and the amounts which would have to be paid in acquiring the right of way, supposing the railroad to be removed, are wholly beyond reach of any process of rational determination. The cost of reproduction method is of service in ascertaining the present value of the plant, when it is reasonably applied and when the cost of reproducing the property may be ascertained

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\* In a paper by Mr. C. F. Staples, member of Minnesota Railroad and Warehouse Commission, dated September 15th, 1913, and entitled "The Unreliability of Unsupported Opinion Evidence in Determining Land Values in Railroad Appraisals", comparisons are made between the expert opinion evidence, in behalf of respondents and petitioner, of the value of a given terminal property in the city of St. Paul. Seven witnesses for the respondent valued the property at from \$75 344 to \$287 043, with an average of \$159 385, while seven other witnesses for the petitioner placed the value at from \$2 003 to \$6 395, with an average of \$3 574. The jury in this case made an award of \$65 916.

The paper also refers to high-class terminal lands in St. Paul and Minneapolis bought at a comparatively recent date (apparently between 1900 and 1905) which cost \$3 069 239, and these lands were valued as of June 30th, 1906, by six real estate experts employed by the railroads, at \$10 104 831, equal to 329.2% of the actual cost to the carriers, although it is stated that "there was no material advance in values from 1900 to 1906, inclusive".

with a proper degree of certainty. But it does not justify the acceptance of results which depend upon mere conjecture. It is fundamental that the judicial power to declare legislative action invalid upon constitutional grounds is to be exercised only in clear cases. The constitutional invalidity must be manifest, and if it rests upon disputed questions of fact the invalidating facts must be proved."

This opinion, when taken literally, appears to be rather drastic, but taken in connection with the cases under discussion it is not unreasonable.

Some of the objections to the reproduction method here set forth apparently would not apply to the case of aqueduct or reservoir properties, which have little or no effect upon the value of lands near them, except as such value is decreased by severance. It should not affect the valuation of strips of land for railroads along those portions of the line where the value of the property has not been materially affected by reason of the presence of the railroad. Other objections would not apply if rational and equitable theories were used by the experts making the valuation.

Two other related portions of the opinion are (pages 450 and 453):

"It is at once apparent that, so far as the estimate rests upon a supposed compulsory feature of the acquisition, it can not be sustained. It is said that the company would be compelled to pay more than what is the normal market value of property in transactions between private parties; that it would lack the freedom they enjoy, and, in view of its needs, it would have to give a higher price. It is also said that this price would be in excess of the present market value of contiguous or similarly situated property. It might well be asked, who shall describe the conditions that would exist, or the exigencies of the hypothetical owners of the property, on the assumption that the railroad were removed? But, aside from this, it is impossible to assume, in making a judicial finding of what it would cost to acquire the property, that the company would be compelled to pay more than its fair market value. It is equipped with the governmental power of eminent domain. In view of its public purpose, it has been granted this privilege in order to prevent advantage being taken of its necessities. It would be free to stand upon its legal rights and it can not be supposed that they would be disregarded."

"That question [the substantial question to be decided] is whether, in determining the fair present value of the property of the railroad company as a basis of its charges to the public, it is entitled to a valuation of its right-of-way not only in excess of the amount invested in it, but also in excess of the market value of contiguous and similarly situated property. For the purpose of making rates, is its land devoted to the public use to be treated [irrespective of improvements] not only as increasing in value by reason of the activities and general prosperity of the community, but as constantly outstripping in this increase all neighboring lands of like character, devoted to other uses?"



The rule laid down in the above quotations, that nothing can be allowed in valuing public service property for the additional cost on account of the compulsory feature of the acquisition of the property, is one which, in some cases, would do great injustice to the corporation if the original cost of property were not known and it were necessary to ascertain its value by other means.

It is a matter of common knowledge to engineers and others connected with the acquisition of rights of way or of tracts of land within specified boundaries, that the municipality or public service corporation, even if exercising the right of eminent domain, is compelled to pay much more for such property than the ordinary market value of the land acquired.

To take a specific instance, namely: the acquisition of real estate for the Wachusett Reservoir in Massachusetts.

In order to make a preliminary estimate of the cost of acquiring the real estate, the first step, after the preparation of plans showing the properties, was the selection of one man as an appraiser in each of the municipalities in which the site of the reservoir was situated, choosing in each case the man best acquainted with the properties and their value. These experts, some of whom owned property required for the reservoir, were instructed to value all of the property, except mills and water rights, on a liberal basis. The aggregate valuation so obtained was:

Land (4 772 acres).....	\$244 000
Buildings.....	453 000    \$697 000

The cost of acquiring the same property, exclusive of overhead charges, was \$1 182 000, which was \$485 000, equal to 69%, in excess of the original liberal appraisal of the value. This excess, which was due to the compulsory feature of the acquisition, was not wholly unexpected, as in the preliminary estimates of the cost of the property 50% was added to the experts' valuation, and to the sum so obtained 15% was added for overhead charges, exclusive of interest, making a total of \$1 200 000.

If it is necessary, in making a preliminary estimate, to add a percentage to the ordinary value of the property to cover the extra cost when the taking is compulsory, why should not a similar percentage be added to the ordinary value of the property in estimating the cost of reproduction?

If the real estate had all been land, and the experts' valuation had been based on actual sales rather than a liberal market price, it is probable that the cost of acquisition would have been from two to three times the preliminary valuation.

This reservoir is situated in a part of a State where land values are very nearly stationary, and any attempt to appraise at the present



time on the basis of the value of contiguous and similarly situated property, without the use of multipliers, would result in a valuation much less than the original cost of the property.

The situation is so very different from that involved in the valuation of terminal properties in the Minnesota Rate Cases, that it hardly seems possible that with the facts presented the Courts could do the injustice which would result from neglecting the compulsory feature as affecting the cost of acquiring such property.

The hasty reader of the opinion under consideration might easily reach the conclusion that under no circumstances would a value of public service property in excess of the market value of contiguous and similarly situated property be approved. The portions of the opinion referred to, given without the context, are as follows:

"It is also said that this price [a price necessarily paid for property] would be in excess of the present market value of contiguous or similarly situated property. It might well be asked, who shall describe the conditions that would exist, or the exigencies of the hypothetical owners of the property, on the assumption that the railroad were removed?"

"That question is whether \* \* \* the railroad company \* \* \* is entitled to a valuation of its right-of-way not only in excess of the amount invested in it, but also in excess of the market value of contiguous and similarly situated property."

This question is answered in part by the following statement:

"It is not admissible to attribute to the property owned by the carriers a speculative increment of value over the amount invested in it and beyond the value of similar property owned by others, solely by reason of the fact that it is used in the public service."

"The increase [in value] so allowed \* \* \* cannot properly extend beyond the fair average of the normal market value of land in the vicinity having a similar character."

"The company would certainly have no ground of complaint if it were allowed a value for these lands equal to the fair average market value of similar land in the vicinity, without additions by the use of multipliers, or otherwise, to cover hypothetical outlays."

The language employed is somewhat perplexing, but when the above extracts from the opinion are read in connection with the context and are also considered in connection with the circumstances of the case, it seems clear that they are not to be construed as meaning that the Courts would not permit valuations, for instance, of strips of land, at a price in excess of the value of contiguous and similarly situated property.

When a strip of land is taken from the middle of a large tract, the owner of the tract is entitled, legally and equitably, not only to the value of the strip based upon the price of similar and contiguous

land, but he is entitled to the consequential damages to the remainder of the tract, all of which enhances the cost and consequently the value of the strip taken. It is obvious that the Court could not under such circumstances refuse to recognize such extra cost and value of the strip.

Still another part of the opinion calls attention to a further increase in the valuation of land which had been approved by the lower Court. The statement is made that the amount allowed for real estate, exclusive of overhead charges (page 450):

“Was included in the total on which  $4\frac{1}{2}$  per cent. was allowed in Item 30 for ‘Engineering, superintendence, legal expenses,’ and again was included in the total on which 5 per cent. was allowed in Item 37 for ‘Contingencies,’ and, in addition, was included in the total on which 10 per cent. was allowed in Item 39 for ‘Interest during construction.’”

Elsewhere the opinion states (page 455):

“We also think it was error to add to the amount taken as the present value of the lands the further sums calculated on that value, which were embraced in the items of ‘engineering, superintendence, legal expenses,’ ‘contingencies’ and ‘interest during construction.’”

If this ruling, instead of being applicable to the particular circumstances of the case under consideration, is intended to have a general application, it is, in the judgment of the Committee, inequitable because the items of cost “engineering, superintendence, legal expenses”, “contingencies” and “interest during construction,” are real items of cost in the acquisition of land, and should be included in any attempt to determine the value of the land on the basis of the cost of reproducing the property, if correct results are to be attained.

The Committee believes that the proper purpose of a cost of reproduction estimate of the value of real estate is to ascertain the cost of acquiring such real estate under the conditions existing at the time of its acquisition, except that if it be admitted that the property is to share in the increase in the value of neighboring land not affected by the use to which the public service property is devoted, it is necessary to use the present rather than the original prices. In order to do this the overhead charges must necessarily be included.

The detailed records of the cost of acquisition of a large tract of real estate are available in the case of the Wachusett Reservoir, as shown by the following statement covering all payments from 1895 to December 1st, 1909:

#### Direct Payments for Property Acquired.

Mill property and water rights, including all land and build-	
ings owned in connection with the mills.....	\$1 402 000
Paid for real estate in reservoir and margins.....	936 200
Paid for real estate beyond the margins of the reservoir....	503 700
Total .....	\$2 841 900

## Overhead Charges.

Administration expenses .....	1.76%	\$50 000
Engineering .....	2.94%	83 600
Legal and expert.....	4.67%	132 800
Taxes and tax equivalents.....	2.24%	63 600
Care of property during construction.		\$84 700
Less credits for rents, etc.....	67 600	0.60%
		17 100
	12.21%	\$3 189 000

To the above overhead charges there should be added the portion of the expenses of the State Treasurer's office and of the State Legal Department, attributable to this work, which were paid for out of general funds and therefore did not appear in these accounts. This would increase the above overhead charges to at least 13%, and after deducting 2.24% attributable to taxes and tax equivalents, there would remain 10.76% for "engineering, superintendence, legal expenses."

Omissions and contingencies which are necessary items in an estimate are, in the case of book accounts, included in the actual payments and do not appear separately. Interest during construction does not appear in these accounts, but they furnish the data from which it may be computed.

The reservoir, although not completed, was sufficiently far advanced at the end of 1903 so that it could be utilized to a limited extent, and this date has been fixed as the date of operation.

Payments on account of real estate in the preceding years were as follows:

1896.....	\$903 000
1897.....	642 000
1898.....	482 000
1899.....	375 000
1900.....	229 000
1901.....	147 000
1902.....	170 000
1903.....	134 000
	\$3 082 000

To conform with the rate of interest generally used in this report, it will be assumed that the interest on these payments was 5% compounded yearly, instead of the smaller amount actually paid. On this basis the interest payments during construction would have been \$957 000, making the charge for interest during construction 31% of the total of all expenditures to the time when the property was



first operated. This is, of course, an unusual charge for interest during construction. Much of the property was acquired a long time before it was needed because more advantageous settlements could be made by so doing.

The real estate in the neighborhood of this reservoir, as already stated, has changed little in value since the time of its acquisition, and if it were to be valued at the present time on the basis of the cost of reproduction without including the extra cost due to the compulsory feature of the acquisition and to the overhead charges, the resulting value would be approximately half its actual cost. It hardly seems possible, in a case like that just stated, that if the cost were not known and it were necessary to determine the value of the real estate on the basis of that of surrounding property, the Court would sustain a ruling, which, when literally applied, would confiscate approximately half the value of the real estate.

The opinion itself indicates that the Court would accept the full amount of the actual investment (which would necessarily include the compulsory feature and the overhead charges) unless such investment was reckless, or improvident, or improper in some other way. It also clearly recognizes that the present value is not limited to the amount of the actual investment, but involves the recognition of the fair value of the property if it be more than its cost. These features are shown by the following quotations (pages 454, 455):

"It is clear that in ascertaining the present value we are not limited to the consideration of the amount of the actual investment. If that has been reckless or improvident, losses may be sustained which the community does not underwrite. As the company may not be protected in its actual investment, if the value of its property be plainly less, so the making of a just return for the use of the property involves the recognition of its fair value if it be more than its cost. The property is held in private ownership and it is that property, and not the original cost of it, of which the owner may not be deprived without due process of law."

"Assuming that the company is entitled to a reasonable share in the general prosperity of the communities which it serves, and thus to attribute to its property an increase in value, still the increase so allowed, apart from any improvements it may make, cannot properly extend beyond the fair average of the normal market of land in the vicinity having a similar character. Otherwise we enter the realm of mere conjecture."

Until the opinion given in the Minnesota Rate Cases shall have been materially modified by the Supreme Court, it is especially desirable, in the case of all properties of fairly recent origin, to ascertain the actual cost of acquiring the real estate, and to use such actual cost as a basis, adding to the cost of the land an increase in

value proportionate to that of similarly situated land not affected in value by the use to which the public service property is devoted.

*Special Value of Land.*—It is sometimes claimed that land has a special value for railroad, reservoir, or other public service purposes, either by reason of its special availability and adaptability for the purpose for which it is to be used, or because it is an inter-connected body of land specially available and adapted by shape and location for the special use.

The Committee believes that this special value should not be included in a valuation, except to the extent of recognizing all the elements which cause such property to cost much more than ordinary property, but if the actual cost has been augmented by a recognition of the special value of land for the purpose for which it is acquired, allowance should be made for such added cost and value. The case is one where the conditions which prevailed at the time of the acquisition of the property should control rather than the present conditions.

*Court Decisions as to Special Value of Land.*—A leading case is that of *Boom Co. v. Patterson*, decided years ago by the United States Supreme Court. It was held that Patterson, who owned three islands in the Mississippi River above St. Anthony's Falls, about an eighth of a mile from its western bank, was entitled to payment, not only for the value of the islands as such, about \$300, but for their availability and adaptability, when connected with one another and with the main land by booms, for creating a receptacle in which millions of logs could be stored, and the Court affirmed a judgment which added about \$5 500 for the availability and adaptability of these islands for the purpose stated.

In the arid lands, where irrigation is necessary for the growth of crops, there are many properties containing small reservoir sites and in the Eastern States there are properties along streams where there are utilized or unutilized falls. Such properties are bought and sold and have a market value, and are properly valued at a special price on account of their availability and adaptability for these purposes.

It is now claimed in some cases that land suitable for a site for a great dam, or land forming a part of a great reservoir site, or again, land available for a railroad location through a narrow pass in the mountains, has a special value by reason of its availability and adaptability for these purposes. This claim is urged even where the dam and reservoir are of such magnitude and involve so great a cost that they could not be built except by the community acquiring the property, and where the pass through the mountains is so located that the possibility is remote that it would ever be used by a railroad.

In nearly all cases the availability and adaptability of these properties for the purposes named are not recognized until preliminary investigations are made and action is taken thereon which finally results in their selection.

Up to the time of such investigations the market value of the property is independent of any consideration of such availability and adaptability. Between the time of such investigation and the actual taking of the property by condemnation, there is sometimes an interval of years during which some of the property may be sold to speculators who have knowledge of the enhanced price usually paid for property when the taking is compulsory, and thereby what is in a sense a new market value may be created.

Occurrences during this interval of time may furnish a basis for testimony that there has been a recognition of the special value of the property for the purposes for which it is taken, but if so, it is an added value incidental to the necessary interval of time between the investigation and taking based upon the necessities of the buyer, and is one which should not be recognized. In order to receive consideration, the special value should have existed before the beginning of the earliest proceedings which led to the taking.

Assuming, for the purpose of discussion, that the land taken has a special value to the community or public utility requiring it, because better adapted for the proposed uses than any other, and that this special availability and adaptability should be considered in determining the value of the property, how is it possible to determine the amount of such additional value by other than the most speculative and hypothetical methods? One method sometimes used is that of comparing the cost of works at the selected site with the cost of works at a site which is less available and adapted to the purpose. For example, it may be assumed that the place selected for the site of a dam is in the narrow part of a gorge where 20 acres required for the construction of the dam would, for ordinary purposes, be valued at \$100 an acre, or \$2 000 for the whole property. Assuming, further, that the most available of other sites is at a point up stream or down stream where the cost of the dam would be increased by \$1 000 000, how could the sum so ascertained be used to determine the special value of the better site? It clearly would not be equitable to pay the owner of the site \$1 000 000 for the special value of his property, and yet the computation does not indicate any other sum.

The other class of evidence, as to such value, would be opinion evidence based upon knowledge acquired and sales made in the interval between the first investigations and the date of taking of the property, and this kind of evidence, although more plausible, should not, in the opinion of the Committee and as already suggested, be



used to create a special value for availability and adaptability when such value did not exist before the investigations were made.

The subject of the special value of land is referred to in Mr. Justice Hughes' opinion in the Minnesota Rate Cases. The discussion related to "the endeavor to apply the cost-of-reproduction method in determining the value of the right of way" (page 451)\*:

"It is urged that, in this view, the company would be bound to pay the 'railway value' of the property. But, supposing the railroad to be obliterated and the lands to be held by others, the owner of each parcel would be entitled to receive on its condemnation its *fair market value* for all its available uses and purposes. If, in the case of any such owner, his property had a peculiar value or special adaptation for railroad purposes, that would be an element to be considered. But still the inquiry would be as to the fair market value of the property; as to what the owner had lost, and not what the taker had gained. The owner would not be entitled to demand payment of the amount which the property might be deemed worth to the company; or of an enhanced value by virtue of the purpose for which it was taken; or of an increase over its fair market value, by reason of any added value supposed to result from its combination with tracts acquired from others so as to make it a part of a continuous railroad right-of-way held in one ownership."

A recent opinion upholding an allowance for reservoir availability and adaptability is that of the United States Circuit Court of Appeals, decided July 15th, 1913, and it relates to a parcel of land taken for the Ashokan Reservoir of the New York Water Supply.

"That the Ashokan site is peculiarly suitable for reservoir purposes cannot be disputed. Indeed, it may almost be said that it is the only available location for a reservoir from which the great City of New York can be supplied with an abundance of pure water. Located, as the city is, on a narrow peninsula, between two tidal rivers, it is evident that the choice of sites which the State can control is an exceedingly limited one. A glance at the map seems to demonstrate the proposition that the supply of water for such an immense number of people must come from a reservoir located west of the Hudson and above the New Jersey line. The Ashokan site could not escape the attention of a competent engineer employed to make the selection. The process of exclusion would inevitably bring him to the Esopus watershed. Its availability for furnishing New York with pure water was appreciated fourteen years ago, when the Ramapo Company was organized for the purpose of selling the water in question, not only to the City of New York, but to other cities of the State located on both banks of the Hudson. The availability of the Ashokan site induced the City of Kingston to make a careful examination of its capacity for furnishing a supply of water to that city. In short, without entering further into details, it can hardly be disputed that the Ashokan site was the natural place for the reservoir

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\* *Simpson et al v. Shepard; Same v. Kennedy; Same v. Shillaber*, 230 U. S., 352, June 9, 1913.

which is to supply the fast-increasing multitude of people who dwell on both sides of the Hudson, and that this availability had been proved and was publicly known long before the City of New York instituted these proceedings. It must have been evident to all intelligent land owners that their property would, in the near future, inevitably be acquired as part of an immense water system. That this demand increased the value of these lands follows as a necessary conclusion. To value them only according to the tons of hay or the bushels of potatoes they produce ignores the other element of value, namely, that their possession was necessary in order that water might be furnished to the increasing millions along the banks of the Hudson."

To refer to a minor feature of this opinion, it refers to the City of Kingston as having examined the Ashokan Reservoir site with reference to its capacity for furnishing a supply of water to that city. Kingston had, in 1910, a population of 25 908. The estimated cost of the reservoir upon this site is upward of \$30 000 000, making the cost per inhabitant of Kingston the prohibitive sum of \$1150, showing that a reservoir upon this site would be unavailable and unadapted to the use of Kingston on account of its cost, and how little weight should be given to such evidence that there was competition for such a property which would give it a special market value.

The Appellate Division of the Supreme Court (130 App. Div., 350, 356) and Court of Appeals (195 N. Y., 573) of New York State passed upon a similar case (*McGovern vs. City of New York*) relating to the compensation for other parcels of land taken for the Ashokan Reservoir, and reached the opposite conclusion from that reached by the United States Circuit Court of Appeals.

The Appellate Division, referring to the action of the Commissioners making the award, said:

"Their duty was to award compensation for the taking of the land and not for the use to which it will be applied when taken."

"It is only when it is shown that it has a market value for some particular use that the availability and adaptability of the property to the use can be taken into account."

"It is true that he [the owner] is not limited in compensation to the use which he makes of his property, but is entitled to a fair market value for any use to which it is adapted by virtue of its location and for which it is available. \* \* \* The value of property is not limited by the present use, or the use for which it is sought, as either may be more or less than its market value. For example, land may be valuable, abstractly considered, for reservoir purposes, but its market value would depend upon a demand for such a purpose. If no one desired the property for a reservoir, its value might be much less than for any other purpose.

\* \* \* "No evidence was given in the present case tending to show that before the land was taken by the city it was regarded as more valuable because of its advantage of location and adaptability for use as a reservoir."

"The appellant did not prove or attempt to prove that the value of the property in question, or any of the property included in the reservoir site, had been increased by its adaptability or availability for reservoir purposes before the commencement of this proceeding. There is no shadow of evidence of any prior demand for the property as a reservoir site or of any customer who would give more for it for that purpose, or of any circumstance by which the value of the parcel in question, as a part of a natural reservoir site, could be estimated or determined."

These cases went to the United States Supreme Court and were decided in June, 1913. The judgment of the lower Court was sustained, but the points considered in this report were not treated at length. The Court referred to "the difficulties in the way of such evidence [that relating to availability and adaptability] and the wide discretion allowed to the trial Court" and added, "Much depends upon the circumstances of the particular case".

In the judgment of the Committee, the enhancement of the value of land on account of its availability and adaptability for special purposes, in cases where the property is especially available and adapted only to the community or public utility acquiring it, is against sound public policy, and a just consideration of the right of the public to have public works created at a fair cost.

#### EXCESS OR DEFICIENCY OF PAST EARNINGS.

It is the view of the Committee that an excess or deficiency of past earnings of an unregulated property should not be considered in making a valuation of the property, except as they may be useful in determining the development expenses. The Committee has been led to reach this conclusion, not because it would necessarily be inequitable to consider such past earnings, and especially recent earnings, but there seems to be no rational basis upon which they can be included. They are important as indicating whether the rates are too high or too low.

If one attempts to consider past earnings in making a valuation, many questions arise. Shall the consideration include the earnings for 2, 5, or 10 years, and if so, why not for a much longer period? If the earnings have been more or less than a fair return upon the capital employed added to a proper sum to cover obsolescence and depreciation of all items of property, is the corporation accountable to the public for the surplus or deficiency, as the case may be?

From the time that a public service commission is authorized to control rates, to fix the amount that the corporation may earn as



a depreciation allowance, and to control methods of accounting, it is desirable and proper to take into account the excess or deficiency of earnings. The public service corporation should be required to account for its surplus, and, on the other hand, due consideration should be given in fixing rates to any deficiency which may occur.

The subject has been very well discussed by Commissioner Prouty of the Interstate Commerce Commission in *Spokane v. Northern Pacific*.\*

Referring to a surplus which had been accumulated and invested in the property, he states:

"Should the Government to-day take note of that surplus for the purpose either of so reducing the rates of the company that no earnings can be made upon this much of the property or with a view to in some sense turn that surplus back again into the hands of the public?

\* \* \* "During all this period the excess has gone into the property, which has gradually become more valuable, and this increased value has reflected itself in the market price of the securities of that company. It is impossible to restore what has been improperly taken in the way of excessive rates to those persons from whom it has been received. The Government, under those circumstances, can not lay hold on this surplus as a fund held in trust for the public.

"This case strongly illustrates the fact that if any Government tribunal is to do justice between the railway and the public, if it is to feel any confidence in the correctness of its conclusions, its supervision must be continuous and not spasmodic. There must be some point of departure and from that point the knowledge of the Government must be accurate and complete. After earnings have once been 'capitalized' and benefits have been 'conferred', when the various independent organizations have been perfected, it is impossible to either know or to undo."

#### ADAPTATION AND SOLIDIFICATION.

When items of property are first ready for use or for operation, they are generally incomplete. If the item of property is a machine, it requires testing and minor changes or sometimes the replacement of parts before it will operate smoothly. A railroad road-bed, built of earth that has been dumped without consolidation will, as the result of running trains and the effect of weather conditions, settle, and earth will be washed from the fresh slopes, so that additional earth, ballast, and labor will be required to produce a solid and full-sized embankment. All such costs required to complete machines and structures are properly chargeable to the capital account, and if the unit prices used in making the valuation do not cover these items, they should be added.

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\* *Spokane v. Northern Pacific Railway Company*, 15 I. C. C. R., 376, 415, February 9, 1909.

If a valuation is to be based on book accounts, it is equally proper to include these items in the valuation, provided duplication is avoided. If the accounts are so kept that these expenditures have been charged to operation, swelling the operating and diminishing the capital account, then they would appear as development expenses, because the deficiency of earnings in the early years of the operation of the property would be greater than if they had been properly charged to the capital account.

Embankments and the slopes of cuttings may become more stable on account of the growth of grass and weeds, and may therefore be considered to be more valuable, but such value as this, which is not the result of expenditure by the corporation, should have no place in the valuation of the property.

#### SHOULD RATES BE BASED ON PHYSICAL VALUE ONLY?

There are several reasons why a physical valuation, taken by itself, furnishes an unsatisfactory basis for determining rates, and other reasons why it does not seem equitable to omit other considerations.

The method of valuation recommended by the Committee is (with some exceptions) based upon the cost of reproduction of the identical existing features of the property. It protects the actual investment in the property, so far as this can be done where a deduction is made for the depreciation of the existing perishable property and where present instead of original prices are used. The result is a physical valuation dealing with the cost of the existing structures, with little regard for merit or efficiency.

*Efficiency Should Be Recognized.*—Engineers probably recognize much better than others that the intrinsic value of any property is not always proportionate to its cost. One property may have been exceptionally well designed and located and be of such a character that it can be operated at comparatively small cost and give a high grade of service, while another property, having the same physical valuation, may have the opposite characteristics, being poorly designed and located, expensive in operation, and furnishing unsatisfactory service.

If the general principle, a fair return on the fair value of the property, is to be construed as a fixed percentage on the physical value of the property, the inferior service would be paid for at a higher rate than the better service. To avoid this result, some modification of the physical valuation or of the rate of return upon such valuation should be made by the rate-making body, with a view to obtaining more equitable results.

Although the Committee recognizes that sound public policy requires a suitable reward for efficiency, it has been unable up to this

time to formulate general rules which recognize this feature, and commends its special consideration to Public Service Commissions and to the Courts in the cases coming before them.

*Boston Consolidated Gas Company: Sliding Scale.*—A method of recognizing efficiency was put into practical use in Massachusetts in 1906, by a legislative act\* which provides that the Boston Consolidated Gas Co. shall sell gas at a "standard price" of 90 cents per 1000 cu. ft., and that the company may pay its stockholders a "standard rate" of 7% per annum on the par value of its stock. If during any year the price charged by the company is less than the "standard price", the company may, during the following year, increase its dividends above the "standard rate" one-fifth of 1% for every cent of reduction in the price of gas below the standard.

Other parts of the act provide for maintaining a surplus fund and limiting its rate of increase and total amount; for issuing, with the approval of the public service body, such additional stock as may be necessary at its market value; for reporting each year the cost of manufacture, including depreciation, and for readjusting the "standard price" at any time after 10 years from the date of the original act.

Under the provisions of this act, gas is now sold for 80 cents per 1000 cu. ft., and the company pays a 9% dividend to its stockholders. !

*Should a Higher Return be Made Upon an Old Favorably Located Property?*—It is frequently the case that an old property which has been in existence, say, 30 years or more, is so favorably located that it has at apparently reasonable rates, rendered satisfactory service and paid continuously for upward of twenty years more than average dividends upon the stock. As instances of this kind of property may be cited railroads between important terminals, water-works having a supply from nearby and adequate sources, and gas-works in growing cities and towns. As a result, the stock of such companies has been sold far above par and the investment in such stock has not been regarded as speculative because the investors had every reason to suppose that the existing conditions would be likely to continue indefinitely.

The question then arises whether the failure to regulate the rates of such property for a long term of years has not in effect warranted the assumption, made by those investing in the property, that rates producing the same liberal return would continue; also whether as a matter of equity the rates should not in the future be fixed on a basis producing a more liberal return than on properties which, by reason of poorer location, although charging higher rates and furnishing less satisfactory service, earn smaller returns than the more favorably located property.

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\* Chapter 422, Acts, 1906.



It has been held by the Committee that the unfavorably located public service property is not entitled to more than reasonable rates for the service it renders even though the property in question becomes a losing venture; conversely, the Committee believes that the favorably located old property should equitably receive liberal treatment by rate-making bodies.

#### CONTINUOUS REGULATIONS BY COMMISSIONS.

The Committee has, in several instances, called attention to the difficulty of carrying out certain equitable and desirable features of valuation and rate regulation where the control of such matters is spasmodic, and not based upon continuous commission control in connection with legislation adapted to obtaining the desired results.

Some of the defective features of spasmodic regulation without adequate laws are:

1.—Valuations vary from time to time with changes in the prices of labor, materials, and land, involving undesirable gain or loss to the investor or the rate-payer, as the case may be, and increasing the hazard of the investor and consequently the rate of interest.

2.—It is impracticable to take account of an excess or deficiency of past earnings, because, if the public service corporation is allowed to charge rates which result in the accumulation of a surplus or deficiency, neither the corporation nor the public can be compelled subsequently to account one to the other therefor.

3.—The prevailing lack of method in determining depreciation allowances may result in earnings by the corporation of much more or less on this account during the life of each item of property than its value, and a similar difficulty is encountered in properly accounting for the appreciation of land and other property which increases in value.

Where it is feasible to obtain suitable legislation and the appointment of intelligent and independent commissions governed in their actions by consideration of equity, uniformly fair relations between the investors and the public can be maintained much more evenly than under present conditions. Accounting under such control would have a more important place than at present.

Under such control the valuation of a new property would be based mainly upon book accounts with such adjustments as might be necessary for the value of services rendered and not paid for; of risks incurred, if the commission acting for the public would not assume the cost of accidents and failures, and of the use of money upon which interest was not actually paid. The cost of developing the business could also be determined on the basis of the accounts.

Allowances for the depreciation in the value of perishable property and for the appreciation in the value of land could be made on a rational basis and charged periodically to the capital account. If the net depreciation allowance in any year or series of years were made too small or too large, the effect of the error would be diminished, because the investor would have, respectively, a larger or smaller remaining capital entitled to an annual return. If after a series of years the depreciation allowances should prove to be more or less than the actual depreciation of the property, the allowances could be increased or diminished to provide a proper adjustment.

A good sized surplus is desirable for preventing frequent changes in rates and dividends, and for producing stable conditions. The gradual creation of such a surplus would be warranted under continuous commission control if it were to be held for the benefit of the public when not needed for maintaining authorized uniform dividends.

#### SUMMARY.

1.—*Report Limited.*—This report is limited to the discussion of valuation for the purpose of rate-making. Valuations for other purposes differ in some respects, for legal and other reasons.

2.—*General Principles.*—The valuation should be such as to lead to equity as between the owner on the one hand and the public on the other. The rates should yield a fair return upon the fair value of the property. The owner, in addition to a reimbursement of the current expenses of operation, is entitled (a) to an annual return, covering interest and profit, for the use of his capital, having in view the risks incidental to the investment, and (b) an annual allowance to provide for the net depreciation in value of all the items of physical property, resulting from all causes, this allowance to be sufficient to pay for all items of property at the time they cease to have value. As earnings are based to a large extent upon rates, they cannot serve as a basis of valuation for rate-making.

3.—*Method of Determining Physical Value.*—The Committee recommends the use of the actual reasonable cost, subject to suitable provisions for the cost of developing the business, for depreciation, etc., as the best basis for valuation of a new or recently created property, and in the case of an old property, the estimated cost of reproducing the property, with similar adjustments. As the actual cost of a new property should be substantially the same as the fairly estimated cost of reproduction of such a property, this is in effect a recommendation of a practically uniform method of valuation.

4.—*Future Properties under Continuous Commission Control* and suitable legislation could be valued best on the basis of actual reasonable cost, using book accounts for the ascertainment of the cost of developing the business and making proper charges in such accounts

for depreciation. Under this method the corporation would avoid the hazard due to the rise and fall in prices.

5.—*Identical Plant should be Valued.*—The valuation should be predicated upon the identical existing plant, and not upon a substitute plant capable of furnishing equally efficient service.

6.—*Unused Property.*—The Courts have indicated that the property to be considered in making a valuation for rate-making should be only that devoted to the public use. A commission may or may not permit the inclusion of a part or the whole of the unused property in the valuation, depending upon the basis adopted by it.

7.—*Reproduction should be under Original rather than Present Conditions.*—The valuation should be based on the conditions existing at the time the various portions of the property were built, but on the prices prevailing at or near the time of the valuation. As the result of the adoption of this view, the cost of pavements laid over water pipes after their installation would not be included in the valuation, but the extra cost of piecemeal construction would be included. Ownership would not at all times control as to the property to be valued; for instance, a railroad built along the margins of a reservoir by a water-works corporation as a substitute for one occupying the site of the reservoir would be valued, while service pipes belonging to the corporation, if laid at the expense of the rate-payers, would not be valued.

8.—*Inventory.*—The inventory of the property should be made in detail and include an allowance for omissions varying in amount with the care and completeness with which it has been made. Due allowance should be made for the amount by which the actual overrun the theoretical quantities.

9.—*Unit Prices* prevailing at or near the date of the valuation should be used rather than original prices, but to make a valuation more stable, the normal or average prices prevailing during a period of from five to ten years prior to the date of the valuation should be used, except where the prices are steadily rising or falling, when prices nearer the date should be used.

10.—*Overhead Charges* should include the indirect and incidental expenses not covered by the unit prices used: preliminary expenses, incidental to investigation, promotion and report; commission for sale of securities; incidental expenses during construction, including engineering, inspection and other fees, administration charges, general expenses, contingencies, and interest and taxes during construction. Such charges have frequently been under-estimated.

11.—*Development Expenses* should be included in the valuation. They have sometimes heretofore been referred to as "Going Value" when this term has been defined as the investment necessary to put the plant into successful operation and to create revenues that justify



its construction. They have also been defined as the difference between the actual return and a fair return upon the fair value of the property during the early years of the operation of the original plant and of subsequent additions. The development expenses connected with ordinary additions to a plant are a much smaller percentage than those connected with the original plant.

12.—*Working Capital*.—A reasonable sum should be included in the valuation for working capital.

13.—*Depreciation Allowance*.—The corporation is entitled to an annual allowance sufficient to pay for all items of property at the time they cease to have value.

14.—*The Depreciated Value of Property Should be Basis for Rate-making*.—The depreciation allowance is in effect a re-payment in instalments from the rate-payer to the corporation of a part of its investment in particular items of property, and the sums repaid should not thereafter appear in the valuation of such items.

15.—*Expectation of Life* is a necessary factor in determining depreciation allowances to pay for items of property during their life.

16.—*Equal-Annual-Payment Method of Determining Depreciation Allowances*.—The most desirable method is one which shall distribute the combined annual charges on account of the plant as equally as practicable among the rate-payers of different years; this result is reached by the Equal-Annual-Payment Method recommended by the Committee. By it the depreciation allowances for any given item of property are so adjusted from year to year that, when taken in connection with the amount which the rate-payer must contribute on account of such item for a fair return on the remaining investment therein, and for repairs and operation thereon, they are substantially equal in each year of the life of such item. The method is illustrated by a table on page 34, and, to aid in its application, extended depreciation tables are appended.

Under this method the depreciation allowances are credited to the capital account, and not distributed as dividends, and replacements become charges against capital. The amount paid to the corporation annually for depreciation allowances would be used for additions, replacements, betterments, or the extinguishment of outstanding obligations, and when not needed for these purposes, would temporarily increase the working capital; the investment would be kept intact and earning a return on the full amount invested. This method conforms to the decisions of the highest Courts.

17.—*The Sinking-Fund Method* assumes that returns are to be based on the full value of an item of property, and that uniform annual payments will be made to a sinking fund which is to be held intact with accretions of interest until the end of the life of the item in question. This method does not meet the requirements of the

Courts in that they object to the establishment of sinking funds by public service corporations, and the highest Court has decided that returns must be based upon the depreciated and not the full value of the property. Sinking fund computations are used to determine the depreciation allowances of the Equal-Annual-Payment Method, the allowances for each year being equal to the sinking fund payment added to the interest on the accumulated fund at the beginning of the year.

18.—*Straight-Line, Actual-Inspection, and Replacement Methods of Determining Depreciation.*—The Straight-Line Method in the case of long-lived property distributes the burden very unequally among the rate-payers of different years, as will be seen by the table on page 40. The Actual-Inspection Method does not determine the amount of the annual depreciation allowance which the corporation is entitled to earn, and is likely to be unfair. The Replacement Method does not provide for paying for items of property during their life, and is especially unfair in the case of long-lived items of property.

19.—*Appreciation.*—Land and water rights generally appreciate in value from year to year. The Committee recommends that such appreciation be treated in the same way that the depreciation of the perishable property is treated, but on the opposite side of the account. Under present practice the appreciation generally inures to the benefit of the corporation, and it may not be feasible to carry out the Committee's recommendation except under necessary legal authority and continuous commission control.

20.—*Method of Valuing Land.*—Land should be valued at present rather than original prices. On account of the difficulty of correctly appraising the value of public service land and of recent decisions of the highest Court, land which has been purchased at a fairly recent date should be valued on the basis of its cost with additions proportionate to the increase in the value of neighboring land not affected by the use to which the public service land is devoted. When it is not practicable to use the cost as a basis, land can be valued most correctly on the basis of present market value of neighboring land of similar character, augmented by the ratio ordinarily found to obtain in that region between land acquired by public service corporations, on the one hand, and by private parties on the other, and subject to the value of the improvements upon the land obtaining at the time of purchase. Those valuing land in cases coming before the Courts should pay due regard to the decision in the Minnesota Rate Cases fully discussed in this report.

21.—*Past Earnings.*—It is the view of the Committee that an excess or deficiency of past earnings of an unregulated property should not be considered in making a valuation, except as may be useful in determining development expenses; but, under continuous commission

control and proper legislation, it would be desirable to take such earnings into account from the beginning of such control.

22.—*Adaptation and Solidification* should be included in valuation to the extent they may have involved the expenditure of money. The increased value due to adaptation and solidification which has resulted from the action of the elements and natural causes without the expenditure of money should not be so included.

23.—*Efficiency should be Rewarded*.—A physical valuation, dealing with the cost of existing structures with little regard to their merit or efficiency, is not by itself a satisfactory basis for rate-making, because it does not offer the reward for efficiency which sound public policy requires. The Committee believes that some incentive, such as a share of the profits or savings resulting from special efficiency, should be given to the corporation, but has not been able up to this time to formulate general rules for providing such reward.

Respectfully presented,

FREDERIC P. STEARNS, *Chairman*,

LEONARD METCALF, *Secretary*,

THOMAS H. JOHNSON,

ALFRED NOBLE,

WILLIAM G. RAYMOND,

J. P. SNOW,

*Committee.\**

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\* Mr. Henry M. Byllesby was appointed on the Committee, but has been unable to take part in its deliberations, and therefore requests that his name be omitted.

This report has been completed under pressure, and some desirable material has been omitted. The Committee therefore reserves the right to add to the report before its final publication.



## DEPRECIATION TABLES.

ACCOMPANYING REPORT OF THE SPECIAL COMMITTEE ON VALUATION  
OF PUBLIC UTILITIES.

INTEREST COMPOUNDED ANNUALLY.

(Value is value at end of year ; Dep. is depreciation during year.)

## 5-YEAR LIFE.

Age.	4%		5%		6%		7%	
	Value.	Dep.	Value.	Dep.	Value.	Dep.	Value.	Dep.
0	100.0000		100.0000		100.0000		100.0000	
1	81.5373	18.4627	81.9025	18.0975	82.2604	17.7396	82.6109	17.3891
2	62.3361	19.2012	62.9002	19.0023	63.4563	18.5041	64.0046	18.6063
3	42.3668	19.9693	42.9477	19.9525	43.5241	19.9822	44.0959	19.9087
4	21.5988	20.7680	21.9976	20.9501	22.3959	21.1282	22.7935	21.3024
5	0.0000	21.5988	0.0000	21.9976	0.0000	22.3959	0.0000	22.7935
		100.0000		100.0000		100.0000		100.0000

## 10-YEAR LIFE.

0	100.0000		100.0000		100.0000		100.0000	
1	91.6709	8.3291	92.0495	7.9505	92.4132	7.5868	92.7623	7.2377
2	83.0086	8.6623	83.7015	8.3480	84.3712	8.0420	85.0179	7.7444
3	73.9998	9.0088	74.9361	8.7654	75.8467	8.5245	76.7314	8.2865
4	64.6308	9.3690	65.7324	9.2037	66.8107	9.0360	67.8648	8.8666
5	54.8869	9.7439	56.0686	9.6638	57.2325	9.5782	58.3776	9.4872
6	44.7533	10.1336	45.9216	10.1470	47.0797	10.1528	48.2263	10.1513
7	34.2144	10.5389	35.2672	10.6544	36.3177	10.7620	37.3644	10.8619
8	23.2538	10.9606	24.0801	11.1871	24.9099	11.4078	25.7421	11.6223
9	11.8549	11.3989	12.3337	11.7464	12.8177	12.0922	13.3063	12.4358
10	0.0000	11.8549	0.0000	12.3337	0.0000	12.8177	0.0000	13.3063
		100.0000		100.0000		100.0000		100.0000

## 15-YEAR LIFE.

0	100.0000		100.0000		100.0000		100.0000	
1	95.0059	4.9941	95.3658	4.6342	95.7037	4.2963	96.0205	3.9795
2	89.8120	5.1939	90.4998	4.8660	91.1497	4.5540	91.7625	4.2580
3	84.4104	5.4016	85.3906	5.1092	86.3224	4.8273	87.2064	4.5561
4	78.7927	5.6177	80.0260	5.3646	81.2054	5.1170	82.3314	4.8750
5	72.9503	5.8424	74.3930	5.6330	75.7815	5.4239	77.1152	5.2162
6	66.8743	6.0760	68.4784	5.9146	70.0322	5.7493	71.5338	5.5814
		6.3192		6.2103		6.0944		5.9722

## 15-YEAR LIFE.—(Continued.)

Age.	4%		5%		6%		7%	
	Value.	Dep.	Value.	Dep.	Value.	Dep.	Value.	Dep.
7	60.5551	6.5719	62.2681	6.5209	63.9378	6.4601	65.5616	6.3901
8	53.9832	6.8348	55.7472	6.8468	57.4777	6.8476	59.1715	6.8375
9	47.1484	7.1081	48.9004	7.1892	50.6301	7.2584	52.3340	7.3160
10	40.0403	7.3925	41.7112	7.5487	43.3717	7.6941	45.0180	7.8282
11	32.6478	7.6882	34.1625	7.9261	35.6776	8.1555	37.1898	8.3762
12	24.9596	7.9957	26.2364	8.3224	27.5221	8.6450	28.8136	8.9625
13	16.9639	8.3156	17.9140	8.7385	18.8771	9.1636	19.8511	9.5899
14	8.6483	8.6483	9.1755	9.1755	9.7135	9.7135	10.2612	10.2612
15	0.0000		0.0000		0.0000		0.0000	
		100.0000		100.0000		100.0000		100.0000

## 20-YEAR LIFE.

0	100.0000	3.3582	100.0000	3.0243	100.0000	2.7185	100.0000	2.4393
1	96.6418	3.4925	96.9757	3.1755	97.2815	2.8815	97.5607	2.6100
2	93.1493	3.6322	93.8002	3.3342	94.4000	3.0545	94.9507	2.7928
3	89.5171	3.7775	90.4660	3.5010	91.3455	3.2377	92.1579	2.9882
4	85.7396	3.9286	86.9650	3.6760	88.1078	3.4320	89.1697	3.1974
5	81.8110	4.0857	83.2890	3.8598	84.6758	3.6379	85.9723	3.4213
6	77.7253	4.2492	79.4292	4.0528	81.0379	3.8561	82.5510	3.6607
7	73.4761	4.4191	75.3764	4.2554	77.1818	4.0876	78.8903	3.9169
8	69.0570	4.5959	71.1210	4.4682	73.0942	4.3328	74.9734	4.1912
9	64.4611	4.7797	66.6528	4.6916	68.7614	4.5928	70.7822	4.4845
10	59.6814	4.9709	61.9612	4.9262	64.1686	4.8684	66.2977	4.7985
11	54.7105	5.1698	57.0350	5.1725	59.3002	5.1604	61.4992	5.1343
12	49.5407	5.3766	51.8625	5.4311	54.1398	5.4701	56.3649	5.4938
13	44.1641	5.5916	46.4314	5.7027	48.6697	5.7982	50.8711	5.8783
14	38.5725	5.8152	40.7287	5.9878	42.8715	6.1462	44.9928	6.2898
15	32.7573	6.0479	34.7409	6.2872	36.7253	6.5149	38.7030	6.7301
16	26.7094	6.2898	28.4537	6.6016	30.2104	6.9059	31.9729	7.2012
17	20.4196	6.5414	21.8521	6.9317	23.3045	7.3202	24.7717	7.7052
18	13.8782	6.8031	14.9204	7.2783	15.9843	7.7593	17.0665	8.2446
19	7.0751	7.0741	7.6421	7.6421	8.2250	8.2250	8.8219	8.8219
20	0.0000		0.0000		0.0000		0.0000	
		100.0000		100.0000		100.0000		100.0000

## 25-YEAR LIFE.

Age.	4%		5%		6%		7%	
	Value.	Dep.	Value.	Dep.	Value.	Dep.	Value.	Dep.
0	100.0000	2.4012	100.0000	2.0952	100.0000	1.8227	100.0000	1.5811
1	97.5988	2.4972	97.9048	2.2001	98.1773	1.9320	98.4169	1.6917
2	95.1016	2.5972	95.7047	2.3100	96.2453	2.0480	96.7272	1.8101
3	92.5044	2.7010	93.3947	2.4254	94.1973	2.1708	94.9171	1.9369
4	89.8034	2.8091	90.9693	2.5468	92.0265	2.3011	92.9802	2.0724
5	86.9943	2.9214	88.4225	2.6742	89.7254	2.4391	90.9078	2.2175
6	84.0729	3.0383	85.7483	2.8078	87.2863	2.5835	88.6903	2.3728
7	81.0346	3.1598	82.9405	2.9482	84.7008	2.7406	86.3175	2.5388
8	77.8748	3.2862	79.9923	3.0957	81.9602	2.9051	83.7787	2.7165
9	74.5886	3.4176	76.8966	3.2504	79.0551	3.0794	81.0622	2.9067
10	71.1710	3.5544	73.6462	3.4129	75.9757	3.2641	78.1555	3.1102
11	67.6166	3.6965	70.2333	3.5836	72.7116	3.4600	75.0453	3.3279
12	63.9201	3.8444	66.6497	3.7627	69.2516	3.6675	71.7174	3.5608
13	60.0757	3.9982	62.8870	3.9509	65.5841	3.8877	68.1566	3.8101
14	56.0775	4.1581	58.9261	4.1485	61.6964	4.1208	64.3465	4.0768
15	51.9194	4.3244	54.7876	4.3559	57.5756	4.3682	60.2697	4.3622
16	47.5950	4.4974	50.4317	4.5736	53.2074	4.6302	55.9075	4.6675
17	43.0976	4.6773	45.8581	4.8024	48.5772	4.9081	51.2400	4.9942
18	38.4203	4.8643	41.0557	5.0424	43.6691	5.2025	46.2458	5.3439
19	33.5560	5.0590	36.0133	5.2946	38.4666	5.5147	40.9019	5.7179
20	28.4970	5.2613	30.7187	5.5593	32.9519	5.8455	35.1840	6.1181
21	23.2357	5.4718	25.1594	5.8373	27.1064	6.1963	29.0659	6.5465
22	17.7639	5.6906	19.3221	6.1291	20.9101	6.5681	22.5194	7.0047
23	12.0733	5.9183	13.1930	6.4356	14.3420	6.9621	15.5147	7.4950
24	6.1550	6.1550	6.7574	6.7574	7.3799	7.3799	8.0197	8.0197
25	0.0000		0.0000		0.0000		0.0000	
		100.0000		100.0000		100.0000		100.0000

## 30-YEAR LIFE.

0	100.0000		100.0000		100.0000		100.0000	
1	98.2170	1.7830	98.4949	1.5051	98.7351	1.2649	98.9414	1.0586
2	96.3627	1.8543	96.9145	1.5804	97.3943	1.3408	97.8086	1.1328
3	94.4342	1.9285	95.2550	1.6595	95.9731	1.4212	96.5966	1.2120
		2.0057		1.7423		1.5065		1.2969



## 30-YEAR LIFE.—(Continued.)

Age.	4%		5%		6%		7%	
	Value.	Dep.	Value.	Dep.	Value.	Dep.	Value.	Dep.
4	92.4285		93.5127		94.4666		95.2997	
5	90.3426	2.0859	91.6831	1.8296	92.8697	1.5969	93.9120	1.3877
6	88.1733	2.1693	89.7622	1.9209	91.1770	1.6927	92.4272	1.4848
7	85.9173	2.2560	87.7451	2.0171	89.3827	1.7943	90.8385	1.5887
8	83.5710	2.3463	85.6272	2.1179	87.4808	1.9019	89.1386	1.6999
9	81.1308	2.4402	83.4034	2.2238	85.4647	2.0161	87.3196	1.8190
10	78.5930	2.5378	81.0685	2.3349	83.3277	2.1370	85.3734	1.9462
11	75.9537	2.6393	78.6167	2.4518	81.0625	2.2652	83.2969	2.0825
12	73.2088	2.7449	76.0424	2.5743	78.6614	2.4011	81.0626	2.2283
13	70.3543	2.8545	73.3394	2.7030	76.1162	2.5452	78.6783	2.3843
14	67.3854	2.9689	70.5012	2.8382	73.4182	2.6980	76.1272	2.5511
15	64.2977	3.0877	67.5212	2.9800	70.5585	2.8597	73.3975	2.7297
16	61.0866	3.2111	64.3921	3.1291	67.5271	3.0314	70.4766	2.9209
17	57.7471	3.3395	61.1065	3.2856	64.3188	3.2133	67.3512	3.1254
18	54.2740	3.4731	57.6567	3.4498	60.9077	3.4061	64.0073	3.3439
19	50.6619	3.6121	54.0344	3.6223	57.2973	3.6104	60.4291	3.5782
20	46.9054	3.7565	50.2310	3.8034	53.4702	3.8271	56.6005	3.8286
21	42.9986	3.9068	46.2374	3.9936	49.4136	4.0566	52.5039	4.0966
22	38.9355	4.0631	42.0441	4.1933	45.1135	4.3001	48.1206	4.3833
23	34.7099	4.2256	37.6412	4.4029	40.5554	4.5581	43.4304	4.6902
24	30.3153	4.3946	33.0181	4.6231	35.7238	4.8316	38.4118	5.0186
25	25.7449	4.5704	28.1638	4.8543	30.6024	5.1214	33.0420	5.3698
26	20.9917	4.7532	23.0670	5.0968	25.1736	5.4288	27.2963	5.7457
27	16.0484	4.9433	17.7151	5.3519	19.4192	5.7544	21.1484	6.1479
28	10.9073	5.1411	12.0957	5.6194	13.3194	6.0998	14.5702	6.5782
29	5.5606	5.3467	6.1952	5.9005	6.8537	6.4657	7.5315	7.0387
30	0.0000	5.5606	0.0000	6.1952	0.0000	6.8537	0.0000	7.5315
		100.0000		100.0000		100.0000		100.0000

## 35-YEAR LIFE.

0	100.0000		100.0000		100.0000		100.0000	
1	98.6423	1.3577	98.8928	1.1072	99.1026	0.8974	99.2766	0.7234
2	97.2902	1.4121	97.7303	1.1625	98.1514	0.9512	98.5026	0.7740
3	95.7617	1.4685	96.5096	1.2207	97.1431	1.0083	97.6744	0.8282
		1.5273		1.2816		1.0688		0.8862

## 35-YEAR LIFE.—(Continued.)

Age.	4%		5%		6%		7%	
	Value.	Dep.	Value.	Dep.	Value.	Dep.	Value.	Dep.
4	94.2344	1.5884	95.2280	1.3458	96.0743	1.1329	96.7882	0.9483
5	92.6460	1.6519	93.8822	1.4131	94.9414	1.2010	95.8399	1.0146
6	90.9941	1.7179	92.4691	1.4837	93.7404	1.2729	94.8253	1.0856
7	89.2762	1.7867	90.9854	1.5579	92.4675	1.3493	93.7397	1.1616
8	87.4895	1.8581	89.4275	1.6358	91.1182	1.4303	92.5781	1.2429
9	85.6314	1.9325	87.7917	1.7176	89.6879	1.5162	91.3352	1.3300
10	83.6989	2.0098	86.0741	1.8085	88.1717	1.6071	90.0052	1.4230
11	81.6891	2.0902	84.2706	1.8936	86.5646	1.7034	88.5822	1.5226
12	79.5989	2.1737	82.3770	1.9833	84.8612	1.8058	87.0596	1.6298
13	77.4252	2.2607	80.3887	2.0877	83.0554	1.9140	85.4303	1.7432
14	75.1645	2.3512	78.3010	2.1922	81.1414	2.0289	83.6871	1.8653
15	72.8133	2.4452	76.1088	2.3017	79.1125	2.1506	81.8218	1.9959
16	70.3681	2.5430	73.8071	2.4168	76.9619	2.2797	79.8259	2.1356
17	67.8251	2.6447	71.3903	2.5377	74.6822	2.4165	77.6903	2.2851
18	65.1804	2.7505	68.8526	2.6645	72.2657	2.5614	75.4052	2.4450
19	62.4299	2.8605	66.1881	2.7978	69.7043	2.7152	72.9602	2.6162
20	59.5694	2.9750	63.3903	2.9376	66.9891	2.8780	70.3410	2.7993
21	56.5944	3.0939	60.4527	3.0845	64.1111	3.0507	67.5447	2.9953
22	53.5005	3.2178	57.3682	3.2388	61.0604	3.2338	64.5494	3.2049
23	50.2827	3.3464	54.1294	3.4007	57.8266	3.4278	61.3445	3.4293
24	46.9363	3.4803	50.7287	3.5708	54.3988	3.6334	57.9152	3.6693
25	43.4560	3.6195	47.1579	3.7492	50.7654	3.8515	54.2459	3.9262
26	39.8365	3.7642	43.4087	3.9367	46.9139	4.0826	50.3197	4.2010
27	36.0723	3.9149	39.4720	4.1337	42.8313	4.3275	46.1197	4.4951
28	32.1574	4.0714	35.3383	4.3403	38.5038	4.5871	41.6226	4.8007
29	28.0860	4.2343	30.9980	4.5572	33.9167	4.8624	36.8139	5.1464
30	23.8517	4.4037	26.4418	4.7851	29.0543	5.1541	31.6675	5.5067
31	19.4480	4.5798	21.6557	5.0244	23.9002	5.4634	26.1608	5.8922
32	14.8682	4.7630	16.6313	5.2756	18.4368	5.7911	20.2686	6.3046
33	10.1052	4.9535	11.3557	5.5394	12.6457	6.1387	13.9640	6.7459
34	5.1517	5.1517	5.8163	5.8163	6.5070	6.5070	7.2181	7.2181
35	0.0000		0.0000		0.0000		0.0000	
		100.0000		100.0000		100.0000		100.0000

## 40-YEAR LIFE.

Age.	4%		5%		6%		7%	
	Value.	Dep.	Value.	Dep.	Value.	Dep.	Value.	Dep.
0	100.0000		100.0000		100.0000		100.0000	
1	98.9476	1.0524	99.1722	0.8278	99.3538	0.6462	99.4991	0.5009
2	97.8532	1.0944	98.3030	0.8692	98.6689	0.6849	98.9631	0.5360
3	96.7150	1.1382	97.3903	0.9127	97.9429	0.7260	98.3896	0.5735
4	95.5312	1.1838	96.4320	0.9583	97.1733	0.7696	97.7760	0.6136
5	94.3001	1.2311	95.4258	1.0062	96.3576	0.8157	97.1194	0.6566
6	93.0198	1.2803	94.3693	1.0565	95.4929	0.8647	96.4168	0.7026
7	91.6882	1.3316	93.2600	1.1093	94.5763	0.9166	95.6651	0.7517
8	90.3034	1.3848	92.0952	1.1648	93.6047	0.9716	94.8607	0.8044
9	88.8632	1.4402	90.8722	1.2230	92.5748	1.0299	94.0001	0.8606
10	87.3654	1.4978	89.5880	1.2842	91.4832	1.0916	93.0791	0.9210
11	85.8077	1.5577	88.2396	1.3484	90.3260	1.1572	92.0938	0.9853
12	84.1876	1.6201	86.8238	1.4158	89.0994	1.2266	91.0394	1.0544
13	82.5028	1.6848	85.3372	1.4866	87.7992	1.3002	89.9113	1.1281
14	80.7503	1.7523	83.7762	1.5610	86.4210	1.3782	88.7042	1.2071
15	78.9282	1.8223	82.1372	1.6390	84.9601	1.4609	87.4125	1.2917
16	77.0330	1.8952	80.4162	1.7210	83.4116	1.5485	86.0304	1.3820
17	75.0620	1.9710	78.6092	1.8070	81.7701	1.6415	84.5517	1.4788
18	73.0121	2.0499	76.7118	1.8974	80.0302	1.7399	82.9694	1.5823
19	70.8802	2.1319	74.7195	1.9923	78.1859	1.8443	81.2764	1.6930
20	68.6631	2.2171	72.6276	2.0919	76.2309	1.9550	79.4648	1.8116
21	66.3572	2.3059	70.4311	2.1965	74.1585	2.0724	77.5264	1.9384
22	63.9592	2.3930	68.1248	2.3063	71.9619	2.1966	75.4523	2.0741
23	61.4652	2.4940	65.7032	2.4216	69.6335	2.3284	73.2331	2.2192
24	58.8715	2.5937	63.1605	2.5427	67.1653	2.4682	70.8585	2.3746
25	56.1740	2.6975	60.4907	2.6698	64.5491	2.6162	68.3177	2.5408
26	53.3686	2.8054	57.6874	2.8033	61.7759	2.7732	65.5990	2.7187
27	50.4510	2.9176	54.7440	2.9434	58.8363	2.9396	62.6900	2.9090
28	47.4167	3.0343	51.6534	3.0906	55.7203	3.1160	59.5774	3.1126
29	44.2610	3.1557	48.4083	3.2451	52.4174	3.3029	56.2469	3.3305
30	40.9791	3.2819	45.0009	3.4074	48.9163	3.5011	52.6833	3.5636
31	37.5659	3.4132	41.4231	3.5778	45.2051	3.7112	48.8702	3.8131
32	34.0161	3.5498	37.6664	3.7567	41.2712	3.9339	44.7902	4.0800
		3.6916		3.9445		4.1699		4.3656



## 40-YEAR LIFE.—(Continued.)

Age	4%		5%		6%		7%	
	Value.	Dep.	Value.	Dep.	Value.	Dep.	Value.	Dep.
33	30.3245	3.8893	33.7219	4.1417	37.1013	4.4200	40.4246	4.6712
34	26.4852	3.9930	29.5802	4.3488	32.6813	4.6853	35.7584	4.9982
35	22.4922	4.1526	25.2314	4.5662	27.9960	4.9664	30.7552	5.3480
36	18.3396	4.3189	20.6652	4.7946	23.0296	5.2644	25.4072	5.7225
37	14.0207	4.4915	15.8706	5.0343	17.7652	5.5802	19.6847	6.1229
38	9.5292	4.6712	10.8363	5.2860	12.1850	5.9151	13.5618	6.5516
39	4.8580	4.8580	5.5503	5.5503	6.2699	6.2699	7.0102	7.0102
40	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
		100.0000		100.0000		100.0000		100.0000

## 45-YEAR LIFE.

0	100.0000	0.8262	100.0000	0.6262	100.0000	0.4700	100.0000	0.3500
1	99.1738	0.8593	99.3738	0.6575	99.5300	0.4983	99.6500	0.3744
2	98.3145	0.8937	98.7163	0.6903	99.0317	0.5283	99.2756	0.4007
3	97.4208	0.9294	98.0260	0.7249	98.5084	0.5597	98.8749	0.4287
4	96.4914	0.9666	97.3011	0.7611	97.9437	0.5934	98.4462	0.4587
5	95.5248	1.0053	96.5400	0.7992	97.3503	0.6290	97.9875	0.4908
6	94.5195	1.0455	95.7408	0.8392	96.7213	0.6668	97.4967	0.5252
7	93.4740	1.0872	94.9016	0.8810	96.0545	0.7068	96.9715	0.5620
8	92.3868	1.1308	94.0206	0.9251	95.3477	0.7492	96.4095	0.6013
9	91.2560	1.1760	93.0955	0.9714	94.5985	0.7941	95.8082	0.6434
10	90.0800	1.2230	92.1241	1.0200	93.8044	0.8418	95.1648	0.6884
11	88.8570	1.2720	91.1041	1.0710	92.9626	0.8923	94.4764	0.7366
12	87.5850	1.3229	90.0311	1.1245	92.0703	0.9459	93.7398	0.7882
13	86.2621	1.3757	88.9086	1.1807	91.1244	1.0025	92.9516	0.8433
14	84.8864	1.4308	87.7279	1.2398	90.1219	1.0628	92.1083	0.9024
15	83.4556	1.4880	86.4881	1.3018	89.0591	1.1265	91.2059	0.9655
16	81.9676	1.5476	85.1863	1.3668	87.9326	1.1941	90.2404	1.0331
17	80.4290	1.6094	83.8195	1.4352	86.7385	1.2657	89.2073	1.1055
18	78.8106	1.6738	82.3843	1.5070	85.4728	1.3417	88.1018	1.1828
19	77.1368	1.7408	80.8773	1.5823	84.1311	1.4222	86.9190	1.2657
20	75.3960	1.8104	79.2950	1.6614	82.7089	1.5075	85.6533	1.3542
21	73.5856	1.8828	77.6336	1.7445	81.2014	1.5979	84.2991	1.4490

## 45-YEAR LIFE.—(Continued.)

Age.	4%		5%		6%		7%	
	Value.	Dep.	Value.	Dep.	Value.	Dep.	Value.	Dep.
22	71.7028	1.9581	75.8891	1.8317	79.6085	1.6989	82.8501	1.5504
23	69.7447	2.0365	74.0574	1.9233	77.9096	1.7954	81.2997	1.6590
24	67.7082	2.1180	72.1341	2.0195	76.1142	1.9033	79.6407	1.7751
25	65.5902	2.2026	70.1146	2.1205	74.2109	2.0174	77.8656	1.8994
26	63.3876	2.2907	67.9941	2.2264	72.1985	2.1383	75.9662	2.0323
27	61.0969	2.3824	65.7677	2.3378	70.0552	2.2668	73.9339	2.1746
28	58.7145	2.4777	63.4299	2.4548	67.7884	2.4028	71.7593	2.3268
29	56.2368	2.5768	60.9751	2.5773	65.3856	2.5469	69.4325	2.4897
30	53.6600	2.6798	58.3978	2.7062	62.8387	2.6997	66.9428	2.6640
31	50.9802	2.7870	55.6916	2.8417	60.1390	2.8617	64.2788	2.8504
32	48.1932	2.8986	52.8499	2.9837	57.2773	3.0334	61.4284	3.0499
33	45.2946	3.0144	49.8662	3.1328	54.2439	3.2155	58.3785	3.2635
34	42.2802	3.1350	46.7334	3.2896	51.0284	3.4083	55.1150	3.4920
35	39.1452	3.2605	43.4438	3.4539	47.6201	3.6129	51.6230	3.7363
36	35.8847	3.3909	39.9899	3.6267	44.0072	3.8296	47.8867	3.9979
37	32.4938	3.5264	36.3632	3.8081	40.1776	4.0594	43.8888	4.2777
38	28.9674	3.6676	32.5551	3.9983	36.1182	4.3029	39.6111	4.5772
39	25.2998	3.8142	28.5568	4.1984	31.8153	4.5612	35.0339	4.8976
40	21.4856	3.9669	24.3584	4.4083	27.2541	4.8348	30.1363	5.2404
41	17.5187	4.1255	19.9501	4.6286	22.4193	5.1249	24.8959	5.6073
42	13.3932	4.2905	15.3215	4.8600	17.2944	5.4323	19.2886	5.9997
43	9.1027	4.4621	10.4615	5.1032	11.8621	5.7584	13.2889	6.4197
44	4.6406	4.6406	5.3583	5.3583	6.1037	6.1037	6.8692	6.8692
45	0.0000		0.0000		0.0000		0.0000	
		100.0000		100.0000		100.0000		100.0000

## 50-YEAR LIFE.

0	100.0000	0.6550	100.0000	0.4777	100.0000	0.3444	100.0000	0.2460
1	99.3450	0.6812	99.5223	0.5015	99.6556	0.3651	99.7540	0.2632
2	98.6638	0.7085	99.0208	0.5267	99.2905	0.3870	99.4908	0.2816
3	97.9553	0.7368	98.4941	0.5529	98.9035	0.4102	99.2092	0.3014
4	97.2185	0.7663	97.9412	0.5806	98.4933	0.4349	98.9078	0.3224
5	96.4522	0.7969	97.3606	0.6097	98.0584	0.4609	98.5854	0.3450

## 50-YEAR LIFE.—(Continued.)

Age.	4%		5%		6%		7%	
	Value.	Dep.	Value.	Dep.	Value.	Dep.	Value.	Dep.
6	95.6553		96.7509		97.5975		98.2404	
7	94.8265	0.8288	96.1108	0.6401	97.1089	0.4886	97.8712	0.3692
8	93.9645	0.8620	95.4386	0.6722	96.5910	0.5179	97.4762	0.3950
9	93.0681	0.8964	94.7329	0.7057	96.0421	0.5489	97.0536	0.4226
10	92.1358	0.9323	93.9919	0.7410	95.4602	0.5819	96.6014	0.4522
11	91.1662	0.9696	93.2138	0.7781	94.8433	0.6169	96.1175	0.4839
12	90.1578	1.0084	92.3968	0.8170	94.1895	0.6538	95.5997	0.5178
13	89.1091	1.0487	91.5390	0.8578	93.4964	0.6931	95.0457	0.5540
14	88.0185	1.0906	90.6382	0.9008	92.7618	0.7346	94.4529	0.5928
15	86.8842	1.1343	89.6925	0.9457	91.9831	0.7787	93.8186	0.6343
16	85.7045	1.1797	88.6994	0.9931	91.1576	0.8255	93.1400	0.6786
17	84.4777	1.2268	87.6567	1.0427	90.2827	0.8749	92.4138	0.7262
18	83.2018	1.2759	86.5619	1.0948	89.3552	0.9275	91.6367	0.7771
19	81.8748	1.3270	85.4123	1.1496	88.3721	0.9831	90.8053	0.8314
20	80.4948	1.3800	84.2052	1.2071	87.3300	1.0421	89.9157	0.8896
21	79.0595	1.4353	82.9378	1.2674	86.2254	1.1046	88.9638	0.9519
22	77.5669	1.4926	81.6017	1.3307	85.0544	1.1710	87.9453	1.0185
23	76.0146	1.5523	80.2097	1.3974	83.8133	1.2411	86.8555	1.0898
24	74.4002	1.6144	78.7425	1.4672	82.4977	1.3156	85.6894	1.1661
25	72.7211	1.6791	77.2020	1.5405	81.1031	1.3946	84.4417	1.2477
26	70.9750	1.7461	75.5844	1.6176	79.6249	1.4782	83.1066	1.3351
27	69.1589	1.8161	73.8860	1.6984	78.0579	1.5670	81.6781	1.4285
28	67.2702	1.8887	72.1026	1.7834	76.3969	1.6610	80.1496	1.5285
29	65.3060	1.9642	70.2300	1.8726	74.6363	1.7606	78.5141	1.6355
30	63.2633	2.0427	68.2639	1.9661	72.7701	1.8662	76.7641	1.7500
31	61.1388	2.1245	66.1994	2.0645	70.7918	1.9783	74.8916	1.8725
32	58.9293	2.2095	64.0317	2.1677	68.6949	2.0969	72.8880	2.0036
33	56.6314	2.2979	61.7556	2.2761	66.4722	2.2227	70.7442	2.1438
34	54.2417	2.3897	59.3657	2.3899	64.1161	2.3561	68.4503	2.2939
35	51.7563	2.4854	56.8562	2.5095	61.6186	2.4975	65.9958	2.4545
36	49.1716	2.5847	54.2215	2.6347	58.9713	2.6473	63.3695	2.6263
37	46.4834	2.6882	51.4549	2.7666	56.1652	2.8061	60.5594	2.8101
38	43.6877	2.7957	48.5499	2.9050	53.1907	2.9745	57.5526	3.0068
		2.9075		3.0501		3.1530		3.2173



## 50-YEAR LIFE.—(Continued.)

Age.	4%		5%		6%		7%	
	Value.	Dep.	Value.	Dep.	Value.	Dep.	Value.	Dep.
39	40.7802		45.4998		50.0377		54.3353	
40	37.7564	3.0238	42.2971	3.2027	46.6955	3.3422	50.8928	3.4425
41	34.6116	3.1448	38.9342	3.3629	43.1528	3.5427	47.2093	3.6835
42	31.3410	3.2706	35.4033	3.5309	39.3975	3.7553	43.2679	3.9414
43	27.9397	3.4013	31.6958	3.7075	35.4170	3.9805	39.0507	4.2172
44	24.4022	3.5375	27.8029	3.8929	31.1976	4.2194	34.5383	4.5124
45	20.7233	3.6789	23.7154	4.0875	26.7250	4.4726	29.7099	4.8284
46	16.8972	3.8261	19.4235	4.2919	21.9840	4.7410	24.5437	5.1662
47	12.9181	3.9791	14.9170	4.5065	16.9587	5.0253	19.0157	5.5280
48	8.7798	4.1383	10.1851	4.7319	11.6317	5.3270	13.1008	5.9149
49	4.4760	4.3038	5.2168	4.9683	5.9852	5.6465	6.7719	6.3289
50	0.0000	4.4760	0.0000	5.2168	0.0000	5.9852	0.0000	6.7719
		100.0000		100.0000		100.0000		100.0000

## 60-YEAR LIFE.

0	100.0000		100.0000		100.0000		100.0000	
1	99.5798	0.4202	99.9172	0.2828	99.8124	0.1876	99.8771	0.1229
2	99.1428	0.4370	99.4202	0.2970	99.6136	0.1988	99.7455	0.1316
3	98.6884	0.4544	99.1084	0.3118	99.4028	0.2108	99.6048	0.1407
4	98.2157	0.4727	98.7810	0.3274	99.1794	0.2234	99.4542	0.1506
5	97.7241	0.4916	98.4373	0.3437	98.9426	0.2368	99.2331	0.1611
6	97.2129	0.5112	98.0763	0.3610	98.6916	0.2510	99.1207	0.1724
7	96.6812	0.5317	97.6973	0.3790	98.4255	0.2661	98.9362	0.1845
8	96.1283	0.5529	97.2993	0.3980	98.1435	0.2820	98.7388	0.1974
9	95.5533	0.5750	96.8815	0.4178	97.8446	0.2989	98.5276	0.2112
10	94.9552	0.5981	96.4427	0.4388	97.5277	0.3169	98.3016	0.2260
11	94.3332	0.6220	95.9821	0.4606	97.1917	0.3360	98.0598	0.2418
12	93.6864	0.6468	95.4984	0.4837	96.8357	0.3560	97.8011	0.2587
13	93.0136	0.6728	94.9905	0.5079	96.4582	0.3775	97.5243	0.2768
14	92.3140	0.6996	94.4572	0.5333	96.0582	0.4000	97.2280	0.2963
15	91.5864	0.7276	93.8972	0.5600	95.6341	0.4241	96.9111	0.3169
16	90.8297	0.7567	93.3092	0.5880	95.1846	0.4495	96.5719	0.3392
17	90.0427	0.7870	92.6918	0.6174	94.7081	0.4765	96.2090	0.3629
		0.8185		0.6481		0.5051		0.3883

## 60-YEAR LIFE.—(Continued).

Age.	4%		5%		6%		7%	
	Value.	Dep.	Value.	Dep.	Value.	Dep.	Value.	Dep.
18	89.2242		92.0437		94.2030		95.8207	
19	88.3730	0.8512	91.3630	0.6807	93.6671	0.5354	95.4053	0.4154
20	87.4877	0.8853	90.6484	0.7146	93.1001	0.5675	94.9607	0.4446
21	86.5670	0.9207	89.8980	0.7504	92.4985	0.6016	94.4850	0.4757
22	85.6095	0.9575	89.1100	0.7880	91.8608	0.6377	93.9761	0.5089
23	84.6137	0.9958	88.2827	0.8273	91.1849	0.6759	93.4315	0.5446
24	83.5781	1.0356	87.4141	0.8686	90.4684	0.7165	92.8487	0.5828
25	82.5010	1.0771	86.5019	0.9122	89.7090	0.7594	92.2252	0.6235
26	81.3809	1.1201	85.5442	0.9577	88.9039	0.8051	91.5581	0.6671
27	80.2159	1.1650	84.5386	1.0056	88.0506	0.8533	90.8442	0.7139
28	79.0044	1.2115	83.4827	1.0559	87.1461	0.9045	90.0804	0.7638
29	77.7444	1.2600	82.3740	1.1087	86.1872	0.9589	89.2631	0.8173
30	76.4340	1.3104	81.2099	1.1641	85.1709	1.0163	88.3886	0.8745
31	75.0711	1.3629	79.9876	1.2223	84.0936	1.0773	87.4529	0.9357
32	73.6538	1.4173	78.7041	1.2835	82.9516	1.1420	86.4517	1.0012
33	72.1797	1.4741	77.3565	1.3476	81.7412	1.2104	85.3803	1.0714
34	70.6468	1.5329	75.9416	1.4149	80.4581	1.2831	84.2341	1.1462
35	69.0524	1.5944	74.4558	1.4858	79.0980	1.3601	83.0075	1.2266
36	67.3944	1.6580	72.8958	1.5600	77.6563	1.4417	81.6951	1.3124
37	65.6699	1.7245	71.2578	1.6380	76.1281	1.5282	80.2908	1.4043
38	63.8765	1.7934	69.5378	1.7200	74.5082	1.6199	78.7883	1.5025
39	62.0114	1.8651	67.7319	1.8059	72.7911	1.7171	77.1805	1.6078
40	60.0717	1.9397	65.8357	1.8962	70.9710	1.8201	75.4602	1.7203
41	58.0544	2.0173	63.8446	1.9911	69.0417	1.9293	73.6195	1.8407
42	55.9564	2.0980	61.7540	2.0906	66.9965	2.0452	71.6500	1.9695
43	53.7744	2.1820	59.5589	2.1951	64.8288	2.1677	69.5426	2.1074
44	51.5052	2.2692	57.2540	2.3049	62.5310	2.2978	67.2876	2.2550
45	49.1453	2.3599	54.8339	2.4201	60.0953	2.4357	64.8748	2.4128
46	46.6909	2.4544	52.2928	2.5411	57.5134	2.5819	62.2932	2.5816
47	44.1383	2.5526	49.6246	2.6682	54.7767	2.7367	59.5307	2.7625
48	41.4837	2.6546	46.8230	2.8016	51.8757	2.9010	56.5750	2.9557
49	38.7228	2.7609	43.8814	2.9416	48.8067	3.0750	53.4123	3.1627
50	35.8516	2.8712	40.7926	3.0888	45.5411	3.2596	50.0282	3.3841
		2.9861		3.2432		3.4551		3.6209

## 60-YEAR LIFE.—(Continued.)

Age.	4%		5%		6%		7%	
	Value.	Dep.	Value.	Dep.	Value.	Dep.	Value.	Dep.
51	32.8655		37.5494		42.0860		46.4073	
52	29.7599	3.1055	34.1441	3.4053	38.4236	3.6624	42.5328	3.8745
53	26.5301	3.2298	30.5685	3.5756	34.5415	3.8821	38.3872	4.1456
54	23.1711	3.3590	26.8141	3.7544	30.4264	4.1151	33.9514	4.4358
55	19.6778	3.4933	22.8720	3.9421	26.0644	4.3620	29.2051	4.7463
56	16.0447	3.6331	18.7328	4.1392	21.4407	4.6237	24.1266	5.0785
57	12.2633	3.7784	14.3866	4.3462	16.5395	4.9012	18.6925	5.4341
58	8.3368	3.9295	9.8231	4.5635	11.3443	5.1952	12.8780	5.8145
59	4.2501	4.0867	5.0314	4.7917	5.8374	5.5069	6.6566	6.2214
60	0.0000	4.2501	0.0000	5.0314	0.0000	5.8374	0.0000	6.6566
		100.0000		100.0000		100.0000		100.0000





